2008

Report of the Fraser River Panel to the Pacific Salmon Commission on the 2008 Fraser River Sockeye Salmon Fishing Season

Prepared by the

Pacific Salmon Commission

May 2012

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REPORT OF THE FRASER RIVER PANEL TO THE PACIFIC SALMON COMMISSION ON THE 2008 FRASER RIVER SOCKEYE SALMON FISHING SEASON

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I. EXECUTIVE SUMMARY

Pre-season Planning

1. Pre-season expectations for Fraser River sockeye salmon were for a median (50p level, Appendix B) abundance of 2,899,000 fish. A Johnstone Strait diversion rate of 29% was used for pre-season planning, but updated to 45% before the start of the season.
2. Pre-season spawning escapement goals were 35,000 Early Stuart, 145,000 Early Summer, 724,000 Summer, 132,000 Birkenhead and 299,000 Late-run sockeye for a total of 1,335,000 spawners (Table 1). The goals for each management group were established by applying Canada's Spawning Escapement Plan (Appendix B) to the forecast run size.
3. For Late-run sockeye, the Panel assumed a continuation of the early upstream migration behaviour and associated high mortality that has occurred since 1996. The pre-season expectation for the median (50%) migration date of Late-run sockeye past Mission was August 16. Based on this expected timing and the 50p level forecast abundance (374,000 fish), the Panel adopted a 20% allowable exploitation rate that left 80% of the run for potential spawning escapement.
4. Management Adjustments (MAs) of 31,000 Early Stuart fish and 36,000 Early Summer fish were added to the spawning escapement targets to increase the likelihood of achieving the targets. These MAs were based on relationships between river conditions (discharge and temperature) and historic differences between lower and upriver escapement estimates. Because Late-run management was based on an exploitation rate limit rather than a spawning escapement target, no Late-run MA was applied.
5. The projected Total Allowable Catch (TAC) of Fraser River sockeye salmon (Table 1) based on the median forecast abundance and agreed deductions was 1,086,000 sockeye, of which 16.5% (179,000 sockeye) were allocated to the United States (U.S.). The U.S. share was to be reduced by up to 3,400 fish due to a payback owed from 2007.
6. Pre-season model runs indicated it was unlikely the Summer-run TAC could be fully harvested, due to the need to constrain fisheries in order to achieve spawning escapement targets for co-migrating Early Summer and Late-run stocks.
7. Extremely cool sea surface temperatures were observed in the winter and spring of 2007-08 in the Gulf of Alaska where Fraser sockeye rear prior to their return. Such conditions are historically associated with early arrival of Fraser sockeye to the British Columbia coast, and a higher proportion of sockeye migration through Juan de Fuca Strait and lower proportion through Johnstone Strait (i.e., a low "diversion rate"). As part of the pre-season planning process the Panel conducted pre-season model runs with earlier than normal arrival times (both 3 and 7 days earlier than the historical median).
8. The Panel adopted a management plan and fishery regime before the fishing season, including the Management Plan Principles and Constraints, Guidelines to Address Late-run Concerns and the 2008 Regulations (Appendices D through F).

In-season Management Considerations

9. Marine migration timing (Figure 3) was the earliest in over thirty years for all management groups. Early marine timing can lead to interpretations of in-season data that are optimistic about the abundance of a run. The expectations of early timing, however, tempered in-season assessments during the early portion of each run and thereby minimized the tendency to over-estimate abundance.
10. The overall Johnstone Strait diversion rate was 10%, which is the lowest observed since 1973.
11. Returns of Summer and Late-run Fraser sockeye were substantially below forecast levels, resulting in severely constrained commercial harvests in both countries.
12. River temperatures were generally warmer than average and flow levels lower than average (Figure 6). Despite this, in-season MA factors for Early Stuart and Early Summer stocks decreased relative to pre-season expectations. This occurred because the effect of generally warmer than average temperatures was offset by the early migration timing of these stocks, which put the fish in the river when temperatures were cooler than modelled pre-season.

Run Size, Catch, Escapement and Run-size Adjustment

13. Returns of adult Fraser sockeye totalled 1,741,000 fish (Tables 8 and 9), 60% of the pre-season forecast and the lowest return on the 2008 cycle since 1928. Divided into management groups, adult returns totalled 34,000 Early Stuart, 453,000 Early Summer, 1,011,000 Summer, 61,000 Birkenhead and 180,000 Late-run sockeye. The Early Stuart return was near the forecast and the Early Summer return exceeded the forecast, while returns of Summer and Late-run stocks were substantially less than forecast.
14. Catches of Fraser River sockeye salmon in all fisheries totalled 573,000 fish, including 481,000 fish caught by Canada, 51,000 fish by the U.S. and 41,000 fish by test fisheries (Table 8). The Canadian catch included 16,000 in commercial, 447,000 fish in First Nations and 16,000 fish in recreational fisheries. In Washington, Treaty Indian fishers caught 40,000 sockeye and All Citizen fishers caught 9,000. The catch in Alaska totalled 1,600 Fraser sockeye.
15. DFO's near-final estimates of spawning escapements to streams in the Fraser River watershed totalled 815,000 adult sockeye (Tables 8 and 9). This escapement was 56% higher than the brood year (2004) escapement of 524,000 adults. The extremely early arrival time and resulting extended freshwater residence times resulted in a 64% spawning success for female sockeye in the Fraser watershed, the second lowest on record and lowest effective female escapement in 40 years.
16. Preliminary run-size adjustment estimates included 132,000 Early Summer, 50,000 Summer, 29,000 Birkenhead and 140,000 Late-run sockeye, for a total of 351,000 sockeye.

Achievement of Objectives

17. In order of descending priority, the goals of the Panel are to achieve the targets for spawning escapement, international sharing of the TAC and domestic catch allocation.
18. In-season management decisions are based on targets for potential spawning escapement (i.e., spawning escapement targets plus MAs). In-season estimates of potential spawning escapement (i.e., Mission escapement minus catch above Mission) were near the targets for Early Stuart (8% under), Summer (17% over) and Late-run (-1% under) sockeye; and substantially over the targets for Early Summer (74% over) and Birkenhead (74% over) sockeye (Table 12). The Panel's success in achieving these in-season targets was primarily due to early detection of the early timing and weak returns of Fraser sockeye, and the Panel's response of severely restraining commercial fisheries.
19. Achievement of spawning escapement targets is assessed post-season by comparing spawning ground estimates of spawner populations with escapement targets derived by applying Canada's Spawning Escapement Plan to the post-season run-size estimates. Upriver estimates of spawning escapement were close to the post-season targets for Early Stuart (12% under), Early Summer (4% over) and Summer-run sockeye (9% over), but substantially below target for Birkenhead (30% under) and Late-run sockeye (93% under) (Table 13). In total, spawning ground estimates were 96,000 fish or 11% less than the target. For Early Stuart sockeye the shortfall was due to the run size being too low to achieve the target given the observed DBE (-16%) and to the catch of 4,000 fish, primarily in First Nations fisheries. For Birkenhead sockeye the main cause was a much larger DBE (-57%) than expected (0%). The shortfall for Late-run sockeye was due to the run size being too small to achieve the spawning escapement target given the very large observed DBE of -93%. With this magnitude of DBE a run size of about 2,100,000 fish would have been necessary to obtain the nominal Late-run target of 144,000 fish (i.e., total run minus 20% exploitation rate limit = 80% of total run).
20. The exploitation rate for Late-run sockeye including Cultus Lake sockeye was 17%, which was less than the 20% limit (Table 14).
21. The international TAC and U.S. share were calculated using in-season estimates of run-size, spawning escapement target, MA and other deductions at the time the Panel relinquished regulatory control of the last U.S. Panel Area (October 4), as described in Annex IV, Chapter 4 of the Pacific Salmon Treaty and the February 15, 2008 Commission Guidance (Appendix C). Using this method, the TAC was 345,000 Fraser sockeye (Table 15). The Washington catch of 49,400 fish was 4,200 fish less than the U.S. share of 53,600 fish (16.5% of the total TAC minus a payback of 3,400 fish due to a catch overage in 2007). (Table 15). Canada's

total harvest of 481,000 fish was 211,000 fish less than their share of 692,000 Fraser sockeye (includes the Aboriginal Fishery Exemption of 400,000 fish).

22. In U.S. Panel Areas, Treaty Indian fishers caught 40,400 fish, which was more than their share of 35,200 fish (Table 16). All Citizen fishers caught 9,000 fish, about half their share of 18,400 fish.
23. Within the Canadian commercial catch of 16,100 fish, Area B seines caught 4,500 fish over their share, Area D gillnets were 500 fish over, Area E gillnets were 3,500 fish under and Area H trollers were 1,500 fish under (Table 17).
24. By-catches of non-Fraser salmon in commercial fisheries regulated by the Fraser River Panel totalled 0 sockeye and 700 pink salmon in 2008 (Table 18). Catches of other Fraser and non-Fraser salmon species included 4,400 chinook, 180 coho, 240 chum and 380 steelhead.

Allocation Status

25. There were no paybacks arising from the 2008 management season to carry forward to 2009 (Table 19).

II. FRASER RIVER PANEL

In 2008, the Panel operated under the terms of Annex IV, Chapter 4 of the Pacific Salmon Treaty between Canada and the U.S.[1] and the February 2008 "Commission Guidance to the Fraser River Panel" (Appendix C). The Treaty specifies that the Fraser River Panel is responsible for in-season management of commercial fisheries that target Fraser River sockeye and pink salmon within the Panel Area (Figure 1), including net fisheries in both countries and the Canadian troll fishery in the Strait of Georgia. Coordination of directed harvest of other salmon species and stocks intercepted in south coast areas is the responsibility of the Southern Panel and the Pacific Salmon Commission (PSC). Regulation of Southern Panel related fisheries is the responsibility of the appropriate agencies in each country.

Prior to the fishing season, the Fraser River Panel recommends a fishery regime and a management plan for Panel Area fisheries to the Pacific Salmon Commission (PSC). The plan is based on: (1) abundance, timing and migration route forecasts and escapement targets for Fraser River sockeye and pink salmon provided by Canada's Department of Fisheries and Oceans (DFO); (2) international catch allocation goals set by the Treaty; (3) domestic catch allocation goals established by each country; (4) management concerns for other stocks and species identified by each country; and (5) historic patterns in migration and fisheries dynamics. In descending priority, the objectives that guide the Panel's decision-making are to: (1) achieve the spawning escapement targets, (2) meet international catch allocation goals, and (3) meet domestic catch allocation objectives. Conservation concerns for other species and stocks that may occur as by-catch in fisheries directed at Fraser sockeye and pink salmon are generally addressed domestically with some international coordination.

All fisheries under Panel regulatory control are closed unless opened by the Panel (Appendix F). The pre-season management plan identifies the approximate pattern of fishery openings required to achieve Panel objectives given pre-season expectations. The Panel typically deviates from this template, however, and determines the actual pattern of fishery openings based on in-season assessments by PSC staff (Staff, Appendix H) of sockeye and pink salmon run size, migration timing and route, in-river migration abundance (Mission passage) and management adjustments. Thus, the Panel responds to deviations from pre-season expectations in their weekly fishing plans and most substantive fishing decisions are based on in-season rather than pre-season assessments. The Fraser River Panel Technical Committee (Appendix K) works in conjunction with Staff (Appendix J) to facilitate Panel activities by providing their respective National sections with technical advice and ensuring timely exchange of data between Staff and the Parties.

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[1] Pacific Salmon Commission. 2009. Report of the Fraser River Panel to the Pacific Salmon Commission on the 2005 Fraser River sockeye and pink salmon fishing season. Appendices A and B. Vancouver, B.C.

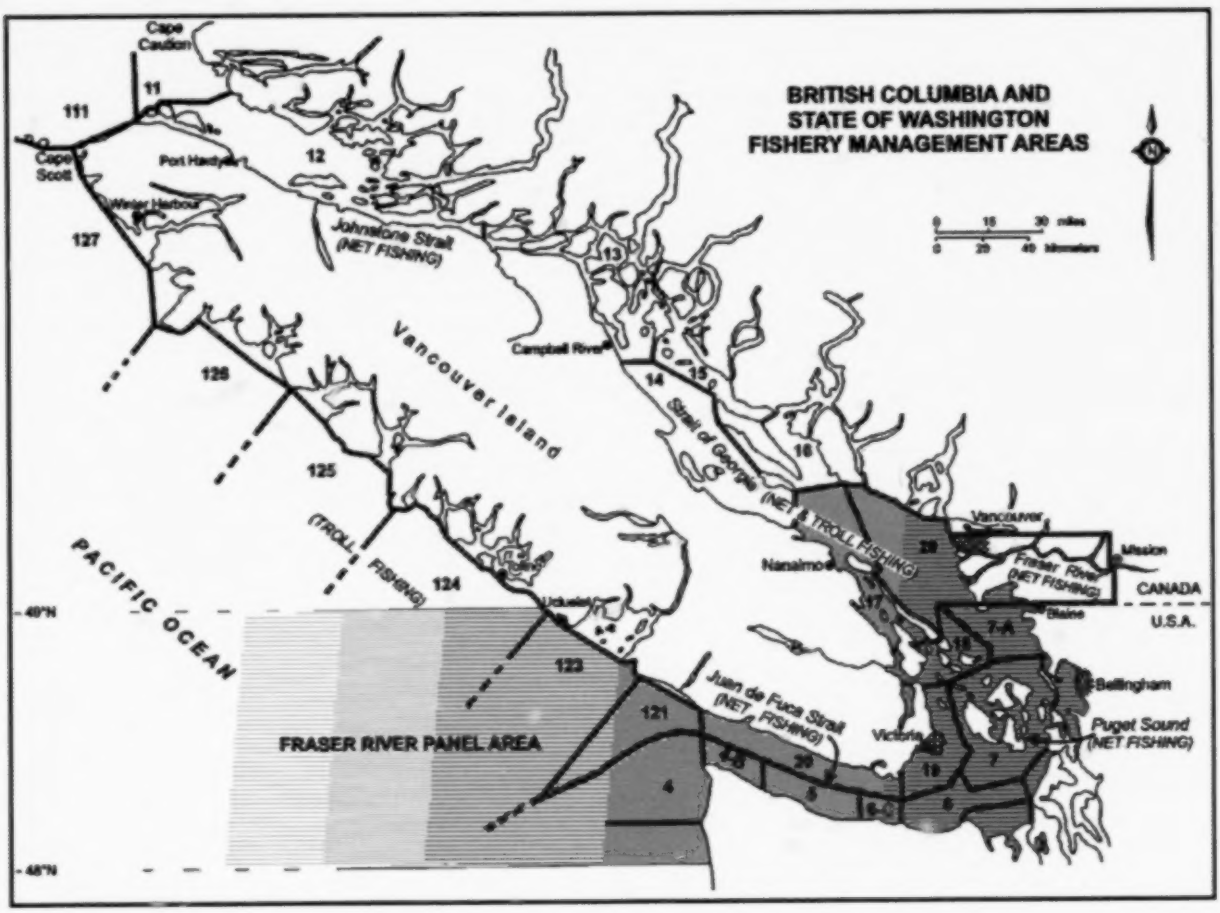

Figure 1. Fishery management areas in the Fraser River Panel Area and Canadian south coast waters.

III. PANEL MANAGEMENT ACTIVITIES

A. Pre-season Planning

Pre-season fisheries management plans for Panel Area fisheries were developed by the Panel using the Fishery Simulation Model[2], which helps to evaluate the impacts of alternative fishery options on the achievement of management objectives. Model inputs include the forecasts of abundance, migration timing, diversion rate and MAs, plus the objectives for spawning escapement and catch allocation.

Due to poor brood year spawner abundance in 2004, sockeye returns in 2008 were expected to be below average for the cycle. Canada presented the Panel with preliminary run-size forecasts for Fraser River sockeye salmon, including forecasts at different probabilities (10%, 25%, 50%, 75% and 90%) that the forecasts would be exceeded (Appendix B, Table 1). The Panel used the median (i.e., 50p or 50% probability level) forecast of 2.9 million Fraser River sockeye as the "base case" scenario for planning purposes (Table 1), thereby accepting equal probabilities that the actual run would be above or below the forecast. The Panel also investigated scenarios based on lower abundances (75p and 90p level forecasts).

[2] Cave, J.D. and W.J. Gazey. 1994. A pre-season simulation model for fisheries on Fraser River sockeye salmon (Oncorhynchus nerka). Can. J. Fish. Aquat. Sci. 51(7): 1535-1549.

Canada used the "Fraser River Sockeye Spawning Initiative" model (FRSSI model) to establish escapement goals for the 2008 management season. The Spawning Escapement Plan released by Canada to the Panel (Appendix B, Table 2) was based on FRSSI guidelines with input from a domestic consultation process. Pre-season escapement targets by management group were: Early Stuart - 35,000 fish, Early Summer - 145,000 fish, Summer - 724,000 fish, Birkenhead - 132,000 fish and Late-run sockeye - 299,000 fish, for a total of 1,335,000 Fraser sockeye spawners (Table 1).

DFO's Environmental Watch Program provided the Panel with long-range projections of Fraser River conditions. Projected discharge levels and water temperatures during sockeye migration were expected to be near normal, with some potential for elevated river temperatures if warmer than normal summer air temperatures developed. Management Adjustment (MA) models developed jointly by PSC and DFO staff used these projections of river conditions to predict how many additional fish should be allowed to escape, to increase the likelihood of achieving the spawning escapement targets. Based on this analysis, the Panel adopted the following pre-season MAs: Early Stuart – 31,000 fish (pMA=0.89), Early Summer – 36,000 fish (pMA=0.25) and Summer-run sockeye – zero fish (pMA=0.00) (Table 1). No Late-run MA was adopted because Late-run sockeye were to be managed using an exploitation rate approach.

TACs and international harvest shares for Fraser sockeye were to be calculated according to Annex IV, Chapter 4 of the Pacific Salmon Treaty and the February 18, 2008 "Commission Guidance to the Fraser River Panel" (Appendix C). The U.S. (Washington) share was 16.5% of the TAC. With a pre-season TAC projection of 1,086,000 fish (Table 1) and a payback of 3,400 fish owed by the U.S., the corresponding U.S. share was 176,000 fish. In terms of domestic goals, Treaty Indian fishers were allocated 67.7% (minus the payback) and All Citizen fishers the remaining 32.3% of the U.S. TAC.

The Canadian share including the 400,000 fish Aboriginal Fishery Exemption (AFE) was 1,309,000 fish. Within non-commercial sectors in Canada, pre-season catch targets for sockeye were 749,000 fish for in-river First Nations and 260,000 fish for marine First Nations, plus projected recreational catches of 15,000 fish in the river and 1,500 fish in marine areas for a total non-commercial catch of 1.0 million fish. In the commercial sector the target of 283,000 fish was divided as follows: 47.5% for Area B purse seines, 18.5% for Area D gillnets, 22.0% for Area E gillnets and 12% for Area H trollers.

Pre-season fisheries management planning was based on assumptions about the proportion of Fraser sockeye that would migrate through Juan de Fuca Strait versus Johnstone Strait (i.e., Johnstone Strait diversion rate, Figure 2), and Area 20 (Juan de Fuca Strait) migration dates as forecasted by DFO. Area 20 dates are indices of marine migration timing and represent the date when 50% of the total run would enter Juan de Fuca Strait if the entire run migrated via that route. The initial forecast that 29% of Fraser sockeye would migrate through Johnstone Strait was revised to 45% on July 11. Forecasted Area 20 dates were July 1 for Early Stuart and August 2 for Chilko sockeye. For planning purposes the Panel used expected Area 20 dates of June 30 for Early Stuart, July 24 for Early Summer, July 30 for Summer, August 6 for Birkenhead and August 7 for Late-run stocks. These marine dates represent earlier than normal timing, which was likely given the unusually cold ocean temperatures in the Gulf of Alaska in the spring of 2008. Projected daily abundance patterns generated from these dates are shown in Figures 3 and 4.

For Late-run stocks, pre-season planning accounted for the likely continuation of early upstream migration behaviour and high en route mortality. Canada proposed a flexible approach to Late-run management, limiting the exploitation rate on Late-run sockeye to 20% at run sizes lower than 500,000 fish. If the run was substantially larger than forecast and the upstream migration significantly later than expected, however, the allowable exploitation rate could increase above 20%. To model Late-run impacts, a 50% Mission date (i.e., date when 50% of the run was expected to pass Mission) of August 16 was adopted, based on the projected Late-run Area 20 date of August 7 plus an eight-day migration to Mission and one-day delay in the Strait of Georgia. Because of low expected abundances and conservation needs for Early Stuart, Early Summer and Late-run sockeye, the model results included severe fishery restrictions, with commercial harvest limited to a narrow window in late July and early August.

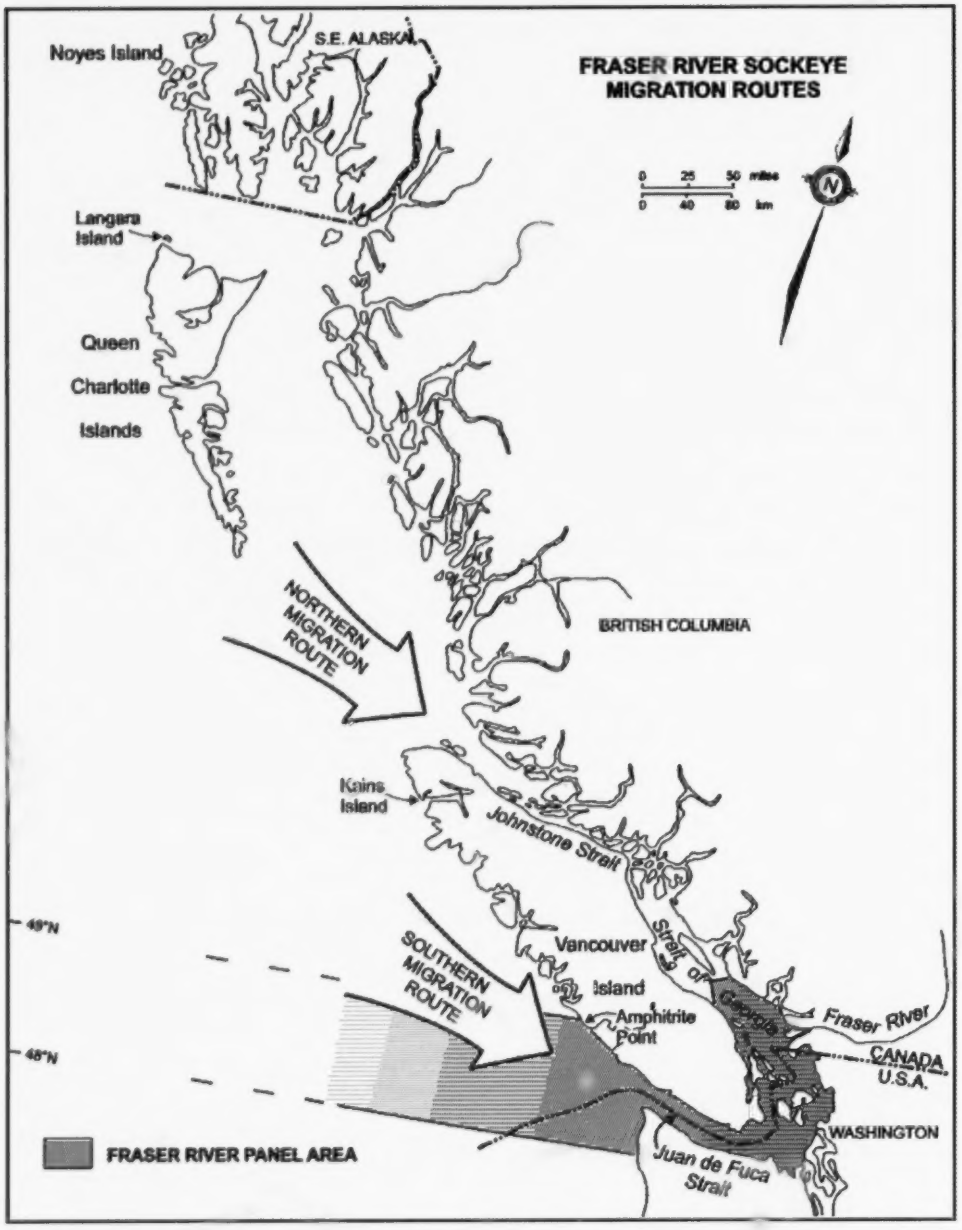

Figure 2. The northern (Johnstone Strait) and southern (Juan de Fuca Strait) routes for sockeye and pink salmon migrating to the Fraser River.

Based on the simulation results the Panel adopted a management plan, which included the "Management Plan Principles and Constraints", "Guidelines to Address Late Run Concerns" and "2008 Regulations" (Appendices D, E and F). Fisheries were expected to start during the week of July 20 – 26 in U.S. and Canadian Panel Areas. It was understood that this schedule would be adjusted if in-season assessments deviated from pre-season expectations.

During the pre-season planning process, both countries identified salmon stocks for which they had conservation concerns and that would influence management decisions for fisheries directed at Fraser sockeye. Canada identified Thompson River coho, lower and upper Strait of Georgia coho, Johnstone Strait coho, summer-run chum, Thompson River steelhead, and west coast Vancouver Island and Harrison River chinook salmon. The U.S. highlighted concerns for Hood Canal summer-run chum and Puget Sound chinook salmon.

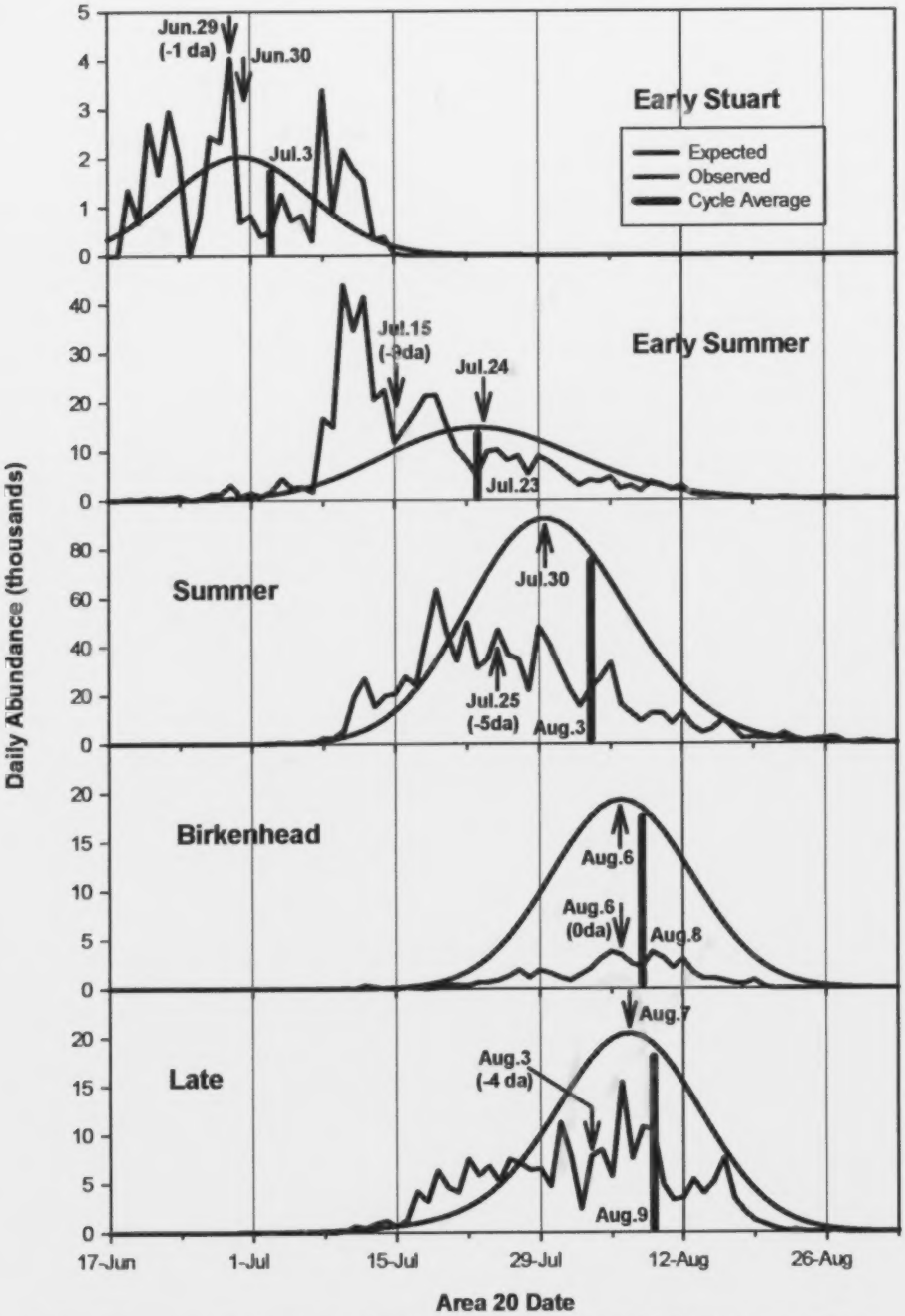

Figure 3. Pre-season expectations and post-season reconstructions of daily abundance of Fraser River sockeye salmon in 2008 (Area 20 date), including the observed 50% dates and number of days difference with pre-season expectations. The cycle-year average date is also shown. This figure shows the earlier-than-expected migration of all groups except Birkenhead, and the low abundance of Summer and Late-run sockeye compared to pre-season expectations.

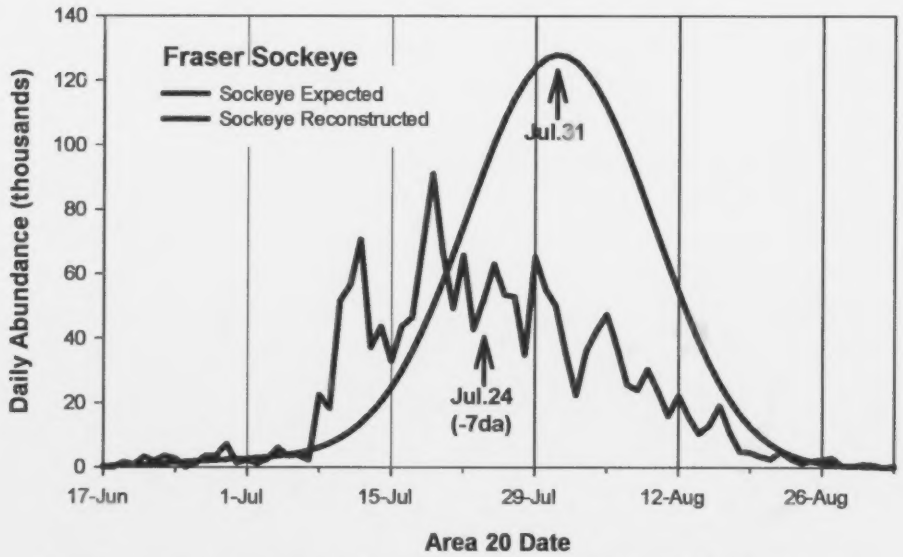

Figure 4. Pre-season expectations and post-season reconstructions of daily abundance of Fraser River sockeye salmon in 2008 (Area 20 date), including the observed 50% date and number of days difference with the pre-season expectation. This figure shows the low abundance and early migration of Fraser sockeye compared to pre-season expectations.

B. In-season Management

With record-setting early migration timing observed for most Fraser sockeye stocks and with Summer and Late-run sockeye abundances well below forecast levels, management of the 2008 Fraser sockeye fishery was challenging. The Panel reacted effectively to these dynamics by severely restricting harvest in Panel-regulated fisheries.

The Fraser River Panel convened 16 times between July 8 and September 25 to discuss run status and enact In-season Orders (Appendix G) to regulate fisheries directed at Fraser River sockeye salmon in Panel Areas.

The main events of the season are summarized below by week, with a focus on Staff assessments and Panel decisions. Corresponding pre-season and in-season data are summarized by meeting date in Table 1, including estimates of run size and the various components that result in the calculated TAC by management group (i.e., spawning escapement target, MA, projected test fishery catch and Aboriginal Fishery Exemption). Also shown are estimates of available harvest (run size minus spawning escapement target and MA), catch to date, Mission passage to date and 50% migration dates.

Also indicated in Table 1 is the date when the U.S. share of the TAC was established ("TAC date", October 4). This is the date on which the Panel relinquished regulatory control of the last U.S. Panel area. As described in the February 15, 2008 Commission Guidance, if the U.S. catch exceeded the U.S. share of the TAC as calculated on this date, and if the run size and TAC on this date was less than when the Panel made its last in-season decision about U.S. fishery openings (July 29), then the U.S. share in future years would not be adjusted for any portion of the catch overage that was due to the reduction in run size between these dates.

Table 1. Pre-season and in-season updates of run size, spawning escapement target and other TAC-related values for Fraser River sockeye salmon in 2008. The available harvest (run size minus spawning escapement target and management adjustment), catch to date, Mission passage to date and migration timing are also shown.

			TAC						Available			50% Migration Date	
Date	Management Group	Total Abundance	Spawning Escapement Target	pMA	Manage-ment Adjust.	Test Fishing	Aboriginal Fishery Exemption	Total Allowable Catch	Harvest (incld. TF + AFE)	Catch to date	Mission Passage to date	Area 20	Mission
June 11 Pre-season	Early Stuart	35,000	35,000	0.89	31,200	200	0	0	0	0	0	30-Jun	6-Jul
	Early Summer	349,000	145,000	0.25	36,100	8,900	100,400	58,600	167,900	0	0	24-Jul	30-Jul
	Summer	1,810,000	724,000	0.00	0	25,900	276,700	783,400	1,086,000	0	0	30-Jul	5-Aug
	Birkenhead	331,000	132,000	0.00	0	3,400	5,600	190,000	199,000	0	0	6-Aug	12-Aug
	Late	374,000	299,000	12.31	na	4,200	17,300	53,500	75,000	0	0	7-Aug	16-Aug
	Sockeye	**2,899,000**	**1,335,000**		**67,300**	**42,600**	**400,000**	**1,085,500**	**1,527,900**	**0**	**0**		
July 15 In-season	Early Stuart	35,000	35,000	0.68	23,800	200	0	0	0	400	33,200	27-Jun	6-Jul
	Early Summer	349,000	145,000	0.25	36,100	8,900	100,400	58,600	167,900	3,400	38,500	24-Jul	30-Jul
	Summer	1,810,000	724,000	0.00	0	25,900	276,700	783,400	1,086,000	2,200	4,500	30-Jul	5-Aug
	Birkenhead	331,000	132,000	0.00	0	3,400	5,600	190,000	199,000	0	0	6-Aug	12-Aug
	Late	374,000	299,000	12.31	na	4,200	17,300	53,500	75,000	100	100	7-Aug	16-Aug
	Sockeye	**2,899,000**	**1,335,000**		**59,900**	**42,600**	**400,000**	**1,085,500**	**1,527,900**	**6,100**	**76,300**		
July 22 In-season	Early Stuart	35,000	35,000	0.68	23,800	200	0	0	0	1,700	39,100	28-Jun	4-Jul
	Early Summer	500,000	200,000	0.25	50,600	8,900	100,400	140,100	249,400	34,700	217,500	24-Jul	30-Jul
	Summer	1,810,000	724,000	0.00	0	25,900	276,700	783,400	1,086,000	31,700	98,900	30-Jul	5-Aug
	Birkenhead	331,000	132,400	0.00	0	3,400	5,600	189,600	198,600	0	500	6-Aug	12-Aug
	Late	374,000	299,200	12.31	na	4,200	17,300	53,300	74,800	1,500	3,400	7-Aug	16-Aug
	Sockeye	**3,050,000**	**1,390,600**		**74,400**	**42,600**	**400,000**	**1,166,400**	**1,608,800**	**69,600**	**359,400**		
July 29 In-season	Early Stuart	40,000	40,000	0.68	27,200	200	0	0	0	2,500	39,100	28-Jun	4-Jul
	Early Summer	425,000	170,000	0.04	7,100	8,900	100,4	138,600	247,900	60,200	317,600	14-Jul	20-Jul
	Summer	1,182,000	520,000	0.00	0	25,900	276,7	359,400	662,000	90,300	343,300	30-Jul	5-Aug
	Birkenhead	331,000	145,600	0.00	0	3,400	5,600	176,400	185,400	2,200	2,400	6-Aug	12-Aug
	Late	374,000	299,200	12.31	na	4,200	17,300	53,300	74,800	7,800	27,300	7-Aug	16-Aug
	Sockeye	**2,352,000**	**1,174,800**		**34,300**	**42,600**	**400,000**	**727,700**	**1,170,100**	**163,000**	**729,700**		
August 1 In-season	Early Stuart	40,000	40,000	0.68	27,200	400	0	0	0	3,100	39,100	28-Jun	4-Jul
	Early Summer	425,000	170,000	0.04	7,100	11,000	114,000	122,900	247,900	82,700	337,400	14-Jul	20-Jul
	Summer	800,000	520,000	0.00	0	20,000	260,000	0	280,000	139,400	444,500	23-Jul	29-Jul
	Birkenhead	137,000	89,100	0.00	0	1,000	6,400	40,500	47,900	2,500	3,000	6-Aug	12-Aug
	Late	232,000	185,600	12.31	na	3,000	19,600	23,800	46,400	10,100	38,200	7-Aug	16-Aug
	Sockeye	**1,634,000**	**1,004,700**		**34,300**	**35,400**	**400,000**	**187,200**	**622,200**	**237,800**	**862,200**		
August 5 In-season	Early Stuart	40,000	40,000	0.68	27,200	400	0	0	0	3,200	39,100	28-Jun	4-Jul
	Early Summer	425,000	170,000	0.04	7,100	11,000	100,400	136,500	247,900	93,600	362,500	14-Jul	20-Jul
	Summer	875,000	520,000	0.00	0	20,000	276,700	58,300	355,000	185,000	538,000	24-Jul	30-Jul
	Birkenhead	50,000	29,700	0.00	0	1,000	5,600	13,700	20,300	3,900	6,900	6-Aug	12-Aug
	Late	183,000	146,400	12.31	na	3,000	17,300	16,300	36,600	15,200	57,400	7-Aug	16-Aug
	Sockeye	**1,573,000**	**906,100**		**34,300**	**35,400**	**400,000**	**224,800**	**659,800**	**300,900**	**1,003,900**		
August 8 In-season	Early Stuart	40,000	40,000	0.68	27,200	400	0	0	0	3,000	39,100	28-Jun	4-Jul
	Early Summer	440,000	176,000	0.04	7,400	11,000	100,400	145,200	256,600	103,600	370,000	14-Jul	20-Jul
	Summer	1,000,000	520,000	0.00	0	20,000	276,700	183,300	480,000	223,800	644,600	25-Jul	31-Jul
	Birkenhead	30,000	15,600	0.00	0	1,000	5,600	7,800	14,400	4,600	11,100	6-Aug	12-Aug
	Late	232,000	185,600	12.31	na	3,000	17,300	26,100	46,400	15,600	70,900	7-Aug	16-Aug
	Sockeye	**1,742,000**	**937,200**		**34,600**	**35,400**	**400,000**	**362,400**	**797,400**	**350,600**	**1,135,700**		
August 12 In-season	Early Stuart	40,000	40,000	0.68	27,200	400	0	0	0	3,000	39,100	28-Jun	4-Jul
	Early Summer	440,000	176,000	0.04	7,400	11,000	100,400	145,200	256,600	117,700	386,000	14-Jul	20-Jul
	Summer	1,000,000	520,000	0.00	0	20,000	276,700	183,300	480,000	297,500	711,300	25-Jul	31-Jul
	Birkenhead	30,000	15,600	0.00	0	1,000	5,600	7,800	14,400	6,900	17,200	6-Aug	12-Aug
	Late	232,000	185,600	12.31	na	3,000	17,300	26,100	46,400	20,000	92,200	7-Aug	16-Aug
	Sockeye	**1,742,000**	**937,200**		**34,600**	**35,400**	**400,000**	**362,400**	**797,400**	**445,100**	**1,245,800**		
August 15 In-season	Early Stuart	40,000	40,000	0.68	27,200	400	0	0	0	3,000	39,100	28-Jun	4-Jul
	Early Summer	450,000	180,000	0.04	7,600	11,500	100,400	150,500	262,400	118,000	390,500	14-Jul	20-Jul
	Summer	925,000	520,000	0.00	0	24,000	276,700	104,300	405,000	305,300	749,600	24-Jul	30-Jul
	Birkenhead	50,000	28,100	0.00	0	1,500	5,600	14,800	21,900	7,600	24,800	5-Aug	11-Aug
	Late	200,000	160,000	12.31	na	4,000	17,300	18,700	40,000	21,900	108,500	31-Jul	8-Aug
	Sockeye	**1,665,000**	**928,100**		**34,800**	**41,400**	**400,000**	**288,300**	**729,300**	**455,800**	**1,312,500**		

Table 1, continued on next page.

Table 1, continued.

Date	Management Group	Total Abundance	TAC: Spawning Escapement Target	pMA	Management Adjust.	Test Fishing	Aboriginal Fishery Exemption	Total Allowable Catch	Available Harvest (incld. TF + AFE)	Catch to date	Mission Passsage to date	50% Migration Date: Area 20	50% Migration Date: Mission
August 19 In-season	Early Stuart	40,000	40,000	0.68	27,200	400	0	0	0	3,000	39,100	28-Jun	4-Jul
	Early Summer	460,000	184,000	0.04	7,700	11,500	100,400	156,400	268,300	125,600	400,700	15-Jul	21-Jul
	Summer	990,000	520,000	0.00	0	24,000	276,700	169,300	470,000	344,000	785,200	25-Jul	31-Jul
	Birkenhead	65,000	34,100	0.00	0	1,500	5,600	23,800	30,900	8,900	35,600	8-Aug	14-Aug
	Late	230,000	184,000	12.31	na	4,000	17,300	24,700	46,000	26,600	129,500	2-Aug	10-Aug
	Sockeye	**1,785,000**	**962,100**		**34,900**	**41,400**	**400,000**	**374,200**	**815,200**	**508,100**	**1,390,100**		
August 26 In-season	Early Stuart	40,000	40,000	0.68	27,200	400	0	0	0	3,000	39,100	28-Jun	4-Jul
	Early Summer	450,000	180,000	0.04	7,600	11,500	100,400	150,500	262,400	127,400	404,600	15-Jul	21-Jul
	Summer	980,000	520,000	0.00	0	24,000	276,700	159,300	460,000	349,300	820,300	25-Jul	31-Jul
	Birkenhead	55,000	29,200	0.00	0	1,500	5,600	18,700	25,800	10,800	41,000	6-Aug	12-Aug
	Late	190,000	152,000	12.31	na	4,000	17,300	16,700	38,000	29,300	149,400	31-Jul	8-Aug
	Sockeye	**1,715,000**	**921,200**		**34,800**	**41,400**	**400,000**	**345,200**	**786,200**	**519,800**	**1,454,400**		
Sep. 25 End-of-season	Early Stuart	40,000	40,000	0.68	27,200	400	0	0	0	3,000	39,300	28-Jun	4-Jul
	Early Summer	450,000	180,000	0.04	7,600	11,600	100,400	150,400	262,400	131,900	412,100	15-Jul	21-Jul
	Summer	980,000	520,000	0.00	0	23,800	276,700	159,500	460,000	387,800	848,700	25-Jul	31-Jul
	Birkenhead	55,000	29,200	0.00	0	1,500	5,600	18,700	25,800	10,900	51,800	6-Aug	12-Aug
	Late	190,000	152,000	12.31	na	4,000	17,300	16,700	38,000	31,900	157,500	31-Jul	8-Aug
	Sockeye	**1,715,000**	**921,200**		**34,800**	**41,300**	**400,000**	**345,300**	**786,200**	**565,500**	**1,509,400**		
October 4 TAC date *	Early Stuart	40,000	40,000	0.68	27,200	400	0	0	0	3,000	39,300	28-Jun	4-Jul
	Early Summer	450,000	180,000	0.04	7,600	11,600	100,400	150,400	262,400	131,900	412,100	15-Jul	21-Jul
	Summer	980,000	520,000	0.00	0	23,800	276,700	159,500	460,000	387,800	848,700	25-Jul	31-Jul
	Birkenhead	55,000	29,200	0.00	0	1,500	5,600	18,700	25,800	10,900	51,800	6-Aug	12-Aug
	Late	190,000	152,000	12.31	na	4,000	17,300	16,700	38,000	31,900	157,500	31-Jul	8-Aug
	Sockeye	**1,715,000**	**921,200**		**34,800**	**41,300**	**400,000**	**345,300**	**786,200**	**565,500**	**1,509,400**		

* The TAC is determined by the run sizes and TAC deductions (spawning escapement targets, management adjustments, projected test fishing catches and AF Exemptions) that were in effect on the day the Panel relinquished regulatory control of the last U.S. Panel Area.

July 6 - 12: Early Stuart sockeye appeared to be arriving at close to the median forecast abundance, although with earlier than expected timing. Both the water temperature and flow in the Fraser River (Figure 6) were slightly above normal for the date.

July 13 - 19: Marine test fishery catches indicated a steady migration of sockeye on both the Canadian and U.S. sides of Juan de Fuca Strait, but a low abundance through Johnstone Strait. Assessments indicated the Early Summer run was more abundant and several days earlier than expected. Conditions in the Fraser River were conducive to sockeye migration, with discharge 20% lower than average and water temperature slightly above normal for the date. Corresponding to the favourable river conditions and earlier than expected Early Stuart migration, the Panel adopted a reduced Early Stuart pMA of 0.68. The Panel also adopted an in-season run-size estimate of 35,000 Early Stuart sockeye (i.e., same as the median forecast). In response to higher than expected Mission escapements of Early Summer and Summer-run stocks, the Panel approved a low impact Treaty Indian driftnet fishery in Areas 4B, 5 and 6C.

July 20 - 26: Test fishery catches continued to build in Juan de Fuca Strait but with little increase in Johnstone Strait, suggesting a low Johnstone Strait diversion rate (Figure 5). Marine timing appeared to be early for all management groups, possibly due to a combination of cool ocean temperatures, ocean currents and larger than average body size of Fraser sockeye. Mission escapements continued to track above expectations for the date, partly due to the early migration timing. River conditions were satisfactory for sockeye migration, with Fraser River discharge 25% lower than average and water temperature only slightly above normal. The Panel adopted an Early Summer run size of 500,000 sockeye. Summer-run sockeye made up the majority of sockeye migrating through marine approaches, and their abundance appeared to be close to the 50p forecast. Fishery openings were approved for a suite of U.S. Treaty Indian and All Citizen fisheries. These openings were earlier than in the pre-season plan due to the earlier than expected timing of Early Summer and Summer-run stocks. The Panel approved low impact ITQ (Individual Transferable Quota) fisheries in Canadian Panel Areas, since they were consistent with pre-season

criteria established for initiating these fisheries. Canada opened additional ITQ fisheries in non-Panel Areas and marine and in-river First Nations FSC fisheries.

July 27 - August 2: A high proportion (about 90%) of sockeye continued to migrate via Juan de Fuca Strait. Staff reported that Summer-run abundance appeared to be significantly below forecast, as indicated by higher than expected proportions of age 5 sockeye (signalling weakness in the age 4 cohort), relatively high proportions of Early Summer and Late-run fish (indicating relatively low Summer-run abundance), and lower than expected daily sockeye abundances in both marine and in-river areas (indicating overall weakness in sockeye abundance). These observations were particularly significant given the continued evidence of very early return timing across all stock groups. The Panel approved a final in-season accounting-based estimate for Early Stuart sockeye of 40,000 fish, and a reduced Early Summer estimate of 425,000 fish with an Area 20 50% date of July 14, which was the earliest on record. The Panel also adopted a reduced Summer-run estimate of 1,182,000 (90p forecast) and later in the week a run of 800,000 fish with an Area 20 50% date of July 23 which, again, was the earliest on record. Early indicators of Late-run abundance suggested that Birkenhead and Late-run abundances would also be substantially lower than forecast. For management purposes, the Panel approved run sizes of 137,000 Birkenhead (90p forecast) and 232,000 Late-run sockeye (75p forecast). River conditions continued to be favourable for migration. Accordingly, the Panel adopted a reduced Early Summer pMA of 0.04. In response to the reduced run sizes, a Treaty Indian fishery in Areas 4B, 5 and 6C was closed one day early and all other commercial fisheries in the U.S. and Canada remained closed. Canadian First Nations FSC (food, social and ceremonial) fisheries continued in marine and in-river areas. July 29 was the date of the last decision about U.S. fisheries, meaning the U.S. share would not be adjusted in future years for any portion of a catch overage that occurred due to reductions in run size after this date.

August 3 - 9: Marine abundances of Fraser sockeye continued at moderate levels while the proportion of Chilko sockeye increased relative to earlier DNA samples, suggesting a protracted Summer-run migration and later marine timing than earlier projections. Marine projections of Mission escapement had also increased. Staff reported that Late-run sockeye appeared to be migrating directly into the Fraser River with no delay in the Strait of Georgia. During this week a number of run-size and timing updates were adopted by the Panel: (1) Early Summer abundance increased to 440,000 fish with an Area 20 50% date of July 14; (2) Summer abundance increased to 1,000,000 fish with an Area 20 50% date of July 25; (3) Birkenhead decreased to 30,000 fish; and (4) Late run decreased to 183,000 fish (Harrison sockeye at 50p and Weaver/Shuswap at 90p forecasts) and then returned to 232,000 fish (75p forecast). Temperatures in the Fraser River remained slightly higher than average for the date and discharge less than average. Based on these data, the Panel adopted an in-season Summer-run MA of zero (unchanged from the pre-season estimate). Due to poor Summer and Late-run returns, all commercial fisheries in the U.S. and Canada remained closed. Canadian First Nations FSC fisheries continued in marine and in-river areas.

August 10 – 16: The marine migration of Fraser sockeye was declining rapidly. Summer and Late-run stocks composed the majority of sockeye migrating through marine areas, although small proportions of Early Summer sockeye were still present. Several run-size updates were adopted by the Panel: (1) Early Summer increased to 450,000 fish; (2) Summer decreased to 925,000 fish (Area 20 50% date of July 24); (3) Birkenhead increased to 50,000 fish (Area 20 50% date of August 5); and (4) Late run decreased to 200,000 fish (47,000 Harrison and 153,000 Weaver/Shuswap sockeye; Area 20 50% date of July 31). Fraser River flows were relatively unchanged from the previous week and temperatures slightly warmer than historic averages for the date. Due to the limited fisheries, the Late-run exploitation rate was tracking far below the maximum limit of 20%. Catches in Canadian First Nations and Panel-approved test fisheries were dropping. All commercial fisheries in Panel and non-Panel waters remained closed, while Canadian First Nations FSC fisheries continued in marine and in-river areas.

August 17 – 23: Migration was nearly complete for many stocks. Assessments were therefore less dependent on model predictions and based more on tallying catches, marine projections and Mission escapements. Recent Mission escapements were higher than had been projected. Consequently, the Panel adopted larger run-size estimates as follows: Early Summer increased to

460,000 fish (Area 20 50% date of July 15); Summer increased to 990,000 fish (Area 20 50% date of July 25); Birkenhead increased to 65,000 fish (Area 20 50% date of August 8); and Late runs increased to 230,000 fish (47,000 Harrison and 183,000 Weaver/Shuswap; Area 20 50% date of August 2). Fraser River flows were near-average for the date, while water temperatures were slightly warmer than average. All commercial fisheries in Panel and non-Panel waters remained closed. Canadian First Nations FSC fisheries continued in marine and in-river areas.

August 24 – 30: The marine migration of Fraser sockeye was nearing completion. Mission escapements were slightly less than projected, so the Panel reduced run-size estimates as follows: Early Summer – 450,000 fish; Summer – 980,000 fish; Birkenhead – 55,000 fish (Area 20 50% date of August 6); and Late runs - 190,000 fish (44,000 Harrison and 146,000 Weaver/Shuswap; Area 20 50% date of July 31).

The Fraser River Panel's end-of-season meeting occurred on September 25, with no revisions to the run size and timing estimates adopted through the end of August (bottom of Table 1). Final in-season estimates included a run size of 1,715,000, available harvest of 786,000, catch of 566,000 and Mission escapement of 1,509,000 Fraser sockeye. Catches fell short of the available harvest for all management groups with the exception of Early Stuart, for which there was a small catch of 3,000 fish (in First Nations FSC and test fisheries) compared to a zero available harvest.

Commercial fishing times in Fraser-sockeye directed Canadian and U.S. fisheries are summarized in Tables 2 and 3, respectively. In Canada, no gillnet fishing was scheduled in Area 20 due to coho conservation concerns. While not under Panel control, management of Canadian non-Panel fisheries directed at Fraser River sockeye salmon is based on the same in-season information and hierarchy of objectives, with priority given to First Nations harvest within Canada's allocation. Although not shown in Table 2, most fishing effort in Canada occurred in such First Nations fisheries.

Table 2. Number of days when fishing occurred in Canadian commercial fisheries that targeted Fraser River sockeye salmon in 2008. Regulatory control of Canadian Panel Areas was relinquished by the Panel on September 6 for Area 20, October 4 for Areas 17 and 18, and October 11 for Area 29, in accordance with pre-season regulations (Appendix F) and in-season orders (Appendix G).

	Panel Areas				Non-Panel Areas			
	20		29	18, 29	11-16			
Date	Purse Seine	Gillnet	Gillnet	Troll	Purse Seine	Gillnet	Troll H	Troll G
Jun.15-Jul.12								
Jul.13-Jul.19								
Jul.20-Jul.26	1			2	1	1	2	
Jul.27-Aug.2	1			1	1	1	1	
Aug.3-Sep.13								
Total	2	0	0	3	2	2	3	0

Table 3. Number of days when fishing occurred in major U.S. net fisheries in the Fraser River Panel Area that targeted Fraser River sockeye salmon in 2008. Regulatory control of U.S. Panel Areas was relinquished by the Panel on September 6 for Areas 4b, 5 and 6c, September 13 for Areas 6, 7 and 7a, and October 4 for the remaining portions of Area 7a , in accordance with pre-season regulations (Appendix F) and in-season orders (Appendix G).

	Treaty Indian		All Citizen		
	Areas	Areas	Areas 7 and 7A		
Date	4B, 5, 6C	6, 7, 7A	Purse Seine	Gillnet	Reefnet
Jun.15-Jul.12					
Jul.13-Jul.19	1				
Jul.20-Jul.26	7		1	1	
Jul.27-Aug.2	7	5	3	3	4
Aug.3-Sep.13					
Total	15	5	4	4	4

IV. MANAGEMENT INFORMATION

To facilitate decision making, the Panel requires information about the abundance, timing, migration route and catch levels of Fraser sockeye by management group. Pre-season, these quantities are provided by DFO in the form of forecasts and by PSC Staff through analysis of historical data. Staff update these estimates in-season through various assessment programs (Appendix H). Stock monitoring programs collect information about abundance at various points along the migration route using test fisheries, hydroacoustic facilities (Mission) and observers (Hells Gate). The locations and schedule for these Staff and DFO programs are listed in Table 4. These data are augmented with information from commercial and First Nations fisheries. Stock identification programs collect and analyze biological samples (e.g., DNA, scales, length) from various fisheries, and the resulting data used to apportion total sockeye estimates into component stock groups. Table 5 shows the stock resolution that was reported in 2008. These stock monitoring and stock identification data are combined with other data to provide estimates of catch, escapement, daily abundance, migration timing, diversion rate and Management Adjustments, which are the basis for estimating total abundances, escapement targets and catch allocations for the different management groups. These data are compiled and analysed by Staff, reviewed by the Technical Committee and the results provided to the Panel.

Information used for Panel management can be divided into three general categories: (1) pre-season forecasts and expectations, on which pre-season planning activities and the management plan are based, (2) in-season estimates that develop over the course of the season and culminate in a set of end-of-season estimates and (3) post-season estimates derived from information that was unavailable during the season, such as spawning ground estimates of escapement, more complete catch estimates, and adjustments to estimates that with hindsight appear to have been biased or incorrect. Key estimates in these categories are summarized in Table 1 and discussed below.

Table 4. Panel-approved stock monitoring operations (test fishery, hydroacoustic and observer) conducted in 2008.

Area	Location	Gear	Dates	Operated by
Canadian Panel Areas				
20	Juan de Fuca Str.	Purse Seine	July 18 - August 20	PSC
20	Juan de Fuca Str.	Gillnet	June 30 - August 12	PSC
29-1 to 6	Str. of Georgia	Troll	Not operated	PSC
29-14	Fraser R. (Cottonwood)	Gillnet	July 14 - September 5	PSC
29-16	Fraser R. (Whonnock)	Gillnet	June 25 - October 3	PSC
29-16	Fraser R. (Mission)	Hydroacoustic	July 9 - August 24	PSC
	Fraser R. (Hells Gate)	Observer	July 2 - August 29	PSC
Canadian non-Panel Areas				
12	Queen Charlotte Str. (Round I.)	Gillnet	July 9 - August 10	DFO
12	Johnstone Str. (Naka Cr.)	Gillnet	July 23 - August 8	DFO
12	Johnstone Str. (Blinkhorn)	Purse Seine	July 21 - August 25	DFO
13	Lower Johnstone Str.	Purse Seine	July 21 - August 25	DFO
United States Panel Areas				
5	Juan de Fuca Str.	Gillnet	July 14 - July 17	PSC
7	San Juan Islands	Reefnet	July 15 - August 19	PSC

Table 5. Individual stocks included in the Fraser River sockeye salmon stock groups used in 2008.

Stock Group	Component Stocks
Early Stuart	
Early Stuart	Early Stuart stocks
Early Summer	
Pitt	Pitt
Chilliwack	Chilliwack Lake, Dolly Varden Creek
Early Miscellaneous	Nadina, Bowron, Gates, Nahatlatch
North Thompson	Fennell, Raft, North Thompson
Seymour/Scotch	Scotch, Seymour, early Eagle, Cayenne, Upper Adams
Summer	
Chilko	Chilko, south end Chilko Lake
Quesnel	Horsefly, McKinley, Mitchell, Roaring, Wasko, Blue Lead
Late Stuart/Stellako	Stellako, Tachie, Middle, Pinchi, Kuzkwa
Birkenhead	
Birkenhead	Birkenhead, Big Silver
Late	
Late Shuswap/Portage	Lower Adams, Portage, Lower Shuswap, Middle Shuswap, Shuswap Lake, late Eagle
Weaver/Cultus	Weaver, Cultus
Harrison	Harrison, Widgeon

A. Abundance

In-season estimates of total Fraser sockeye abundance generally declined from the pre-season forecast of 2,899,000 fish to a low of 1,573,000 sockeye on August 5 and then 1,715,000 fish at the end of the season (Table 1). The expectation of early arrival timing was an important factor in the early in-season identification of lower than forecasted abundances and was critical to the achievement of conservation objectives. Preliminary post-season estimates are slightly higher at 1,741,000 fish, which is 60% of the 50p forecast of 2,899,000 fish and close to the 75p forecast of 1,854,000 fish (Appendix B).

B. Migration Timing and Diversion Rate

Both in-season and post-season estimates of marine migration timing in 2008 were earlier than pre-season expectations, which themselves represented earlier than normal migrations (Table 1 and Figure 3). Post-season estimates of Early Stuart Area 20 timing was one day earlier than expected, Early Summer timing nine days earlier, Summer timing five days earlier and Late-run timing four days earlier than expected. Birkenhead sockeye arrived with expected timing, while the Harrison component of the Late run had an Area 20 50% date of July 22, eight days earlier than projected. The Area 20 50% dates for all management groups were either the earliest or matched the earliest in datasets that begin in the early 1980s.

Diversion rates in 2008 (Figure 5) were considerably lower than forecast for Fraser sockeye. The observed annual diversion through Johnstone Strait was 10% of the Fraser sockeye return, compared to the initial forecast of 29% used for pre-season planning and the updated forecast of 45% provided in July. Following the usual pattern, the rate of sockeye migration through Johnstone Strait generally increased as the season progressed.

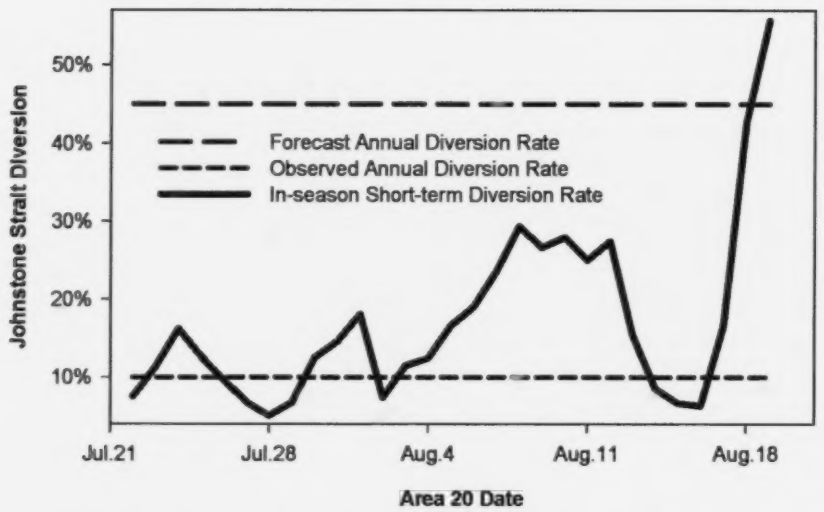

Figure 5. Pre-season forecast of annual Johnstone Strait diversion for Fraser River sockeye salmon, compared to short-term and annual rates estimated during the in-season period.

C. Management Adjustments and DBEs

Management Adjustments are based on statistical models [3,4,5] that consider the historical differences (DBEs) between in-season projections of spawning escapement (i.e., Mission escapement minus catch above Mission, or "potential spawning escapement") and post-season estimates (i.e., spawning ground estimates). For Early Stuart, Early Summer and Summer-run stocks, the models relate historical DBEs to river conditions measured near Hells Gate in the Fraser River. When discharge levels or temperatures are high, DBEs also tend to be high. In addition, for Early Stuart and Early Summer runs, in-season estimates are consistently higher than spawning ground estimates even when migration conditions are within normal ranges, and this tendency is also captured by the MA models. For Late-run sockeye, historical DBEs are related to the date when half the run has migrated past Mission (i.e., 50% date), which captures the effect of the early migration observed since the mid 1990s on the migration success of these stocks.

While pre-season MAs and DBEs are based on median values from the historical dataset or on long-range forecasts of river conditions, in-season estimates are obtained using pre-season or in-season migration timing estimates, and observed and short-range forecasts of river discharge and temperature levels. In contrast, post-season values are calculated independent of any environmental data using post-season estimates of potential spawning escapement (i.e., Mission escapement minus catch above Mission) and spawning ground estimates.

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[3] Hague, M.J., and Patterson, D.A. 2007. Quantifying the sensitivity of Fraser River sockeye salmon (Oncorhynchus nerka) management adjustment models to uncertainties in run timing, run shape and run profile. Can. Tech. Rep. Fish. Aquat. Sci. 2776 : vii + 55p.

[4] Macdonald, J.S., Patterson, D.A., Guthrie, I., Lapointe, M. 2008. Improvements to environmental management adjustment models: SEF final report.

[5] Macdonald, J.S., Patterson, D.A., Hague, M.J., and Guthrie, I.C. 2010. Modeling the influence of environmental factors on spawning migration mortality for sockeye salmon fisheries management in the Fraser River, British Columbia. Transactions of the American Fisheries Society 139:768–782.

Table 6. Pre-season, in-season and observed differences between estimates (DBEs) of potential spawning escapement (Mission escapement minus catch above Mission) and spawning ground abundance.

Description	Early Stuart		Early Summer		Summer		Birkenhead		Late (excld. Birk.)	
	%DBE	pMA	%DBE	pMA	%DBE	pMA	%DBE	pMA	%DBE	pMA
Pre-season prediction *	-47%	0.89	-20%	0.25	0%	0.00	0%	0.00	-92%	12.31
In-season prediction **	-40%	0.68	-4%	0.04	0%	0.00	0%	0.00	-92%	12.31
Observed ***	-16%	0.18	-41%	0.70	-5%	0.05	-57%	1.32	-93%	14.00

* Prediction based on pre-season estimates of migration timing and river conditions.

** Prediction based on in-season estimates of migration timing, and observed and short-term projections of river conditions.

*** Estimate from Mission-based potential spawning escapement and enumerated spawning populations.

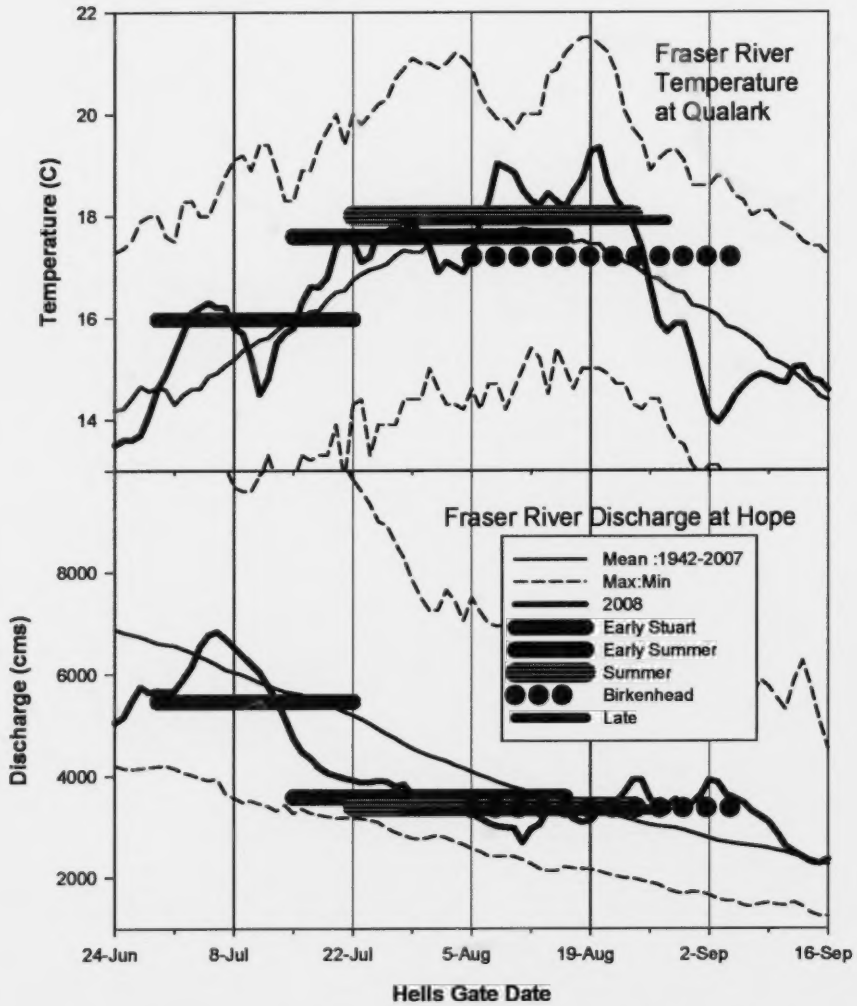

Figure 6. Fraser River temperature and discharge measured near Hope in 2008, with mean temperature and discharge during the central 90% of the migration of each Fraser sockeye management group (excluding Pitt).

Comparisons of %DBE estimates for the pre-season, in-season and post-season periods are shown in Table 6. In-season estimates were close to pre-season forecasts for Early Stuart, Summer and Late runs, and lower for Early Summer stocks. However, observed DBEs for were much less than either pre-season or in-season estimates for Early Stuart, much larger for Early Summer and Birkenhead, slightly larger for Summer and very close for Late-run stocks.

Both river temperatures and discharge levels deviated from historic means, but not severely (Figure 6). River temperatures tended to be warmer than average and discharge levels lower than average. However, the very early migration of the Early and Summer runs meant that they migrated upriver during time periods when river temperatures tend to be lower. Thus, the impact of generally warmer temperatures on in-season MA estimates may have been partially offset by the earlier than normal migrations.

D. Mission Escapement

Estimates of the daily number of sockeye salmon that migrate upstream past the Mission hydroacoustic site are critically important information for in-season management, affecting estimates of total run size, projections of sockeye abundance between marine assessment areas (Juan de Fuca and Johnstone Straits) and the Fraser River, and estimates of the number of fish that successfully migrate into the lower river. Such estimates of sockeye passage at Mission are obtained primarily by hydroacoustic methods, but at times (early and late in the season) may be supplemented by expanded CPUE estimates derived from in-river test fisheries. Mission escapement estimates totalled 1,509,000 sockeye, including 39,000 Early Stuart, 412,000 Early Summer, 849,000 Summer, 52,000 Birkenhead and 158,000 Late-run sockeye (Table 7).

Table 7. Final in-season estimates of Fraser River sockeye salmon passage at Mission in 2008.

Management Group Stock Group	Mission Passage
Early Stuart	**39,300**
Early Summer	**412,100**
Chilliwack	80,600
Early Miscellaneous	220,700
Seymour/Scotch	26,300
North Thompson	64,100
Pitt	20,500
Summer	**848,700**
Chilko	373,600
Quesnel	57,800
Late Stuart/Stellako	417,300
Birkenhead	**51,800**
Late	**157,500**
Late Shuswap/Portage	15,100
Weaver/Cultus	105,700
Harrison	36,700
Total	**1,509,400**

Table 8. Catch, escapement, run-size adjustment and run size estimates for Fraser River sockeye salmon by management group in 2008.

	Fraser Sockeye						
	Early Stuart	Early Summer	Summer	Birken -head	Late	Total	% of Run
CANADIAN CATCH	**3,700**	**110,400**	**337,400**	**7,400**	**22,300**	**481,100**	**28%**
Commercial Catch	**0**	**2,600**	**10,600**	**1,000**	**2,100**	**16,200**	**1%**
Panel Area	0	1,800	7,300	800	1,600	11,600	1%
Non-Panel Areas	0	800	3,200	200	500	4,600	0%
First Nations Catch	**3,700**	**104,800**	**312,500**	**6,400**	**19,900**	**447,300**	**26%**
Marine FSC	0	4,100	19,500	2,400	5,800	31,900	2%
Fraser River FSC	3,700	100,700	293,000	3,900	14,100	415,400	24%
Economic Opportunity	0	0	0	0	0	0	0%
Non-commercial Catch	**0**	**3,000**	**14,300**	**100**	**300**	**17,600**	**1%**
Marine Recreational	0	0	100	0	0	100	0%
Fraser Recreational	0	2,800	13,500	0	100	16,400	1%
Charter	0	200	700	100	200	1,200	0%
ESSR	0	0	0	0	0	0	0%
UNITED STATES CATCH	**0**	**10,300**	**35,700**	**1,200**	**3,700**	**51,000**	**3%**
Washington Total	**0**	**9,900**	**34,800**	**1,200**	**3,600**	**49,400**	**3%**
Commercial catch	**0**	**9,700**	**33,700**	**1,100**	**3,500**	**48,000**	**3%**
Treaty Indian	0	8,600	26,700	800	2,900	39,000	2%
All Citizen	0	1,100	7,000	300	600	9,000	1%
Non-commercial Catch	**0**	**200**	**1,100**	**100**	**100**	**1,400**	**0%**
Ceremonial	0	200	1,100	100	100	1,400	0%
Recreational	0	0	0	0	0	0	0%
Alaska	**0**	**400**	**900**	**100**	**200**	**1,600**	**0%**
TEST FISHING CATCH	**400**	**11,600**	**23,800**	**1,500**	**4,000**	**41,300**	**2%**
PSC (Panel Areas)	**400**	**10,800**	**20,600**	**1,100**	**3,300**	**36,200**	**2%**
Canada	400	7,300	15,700	900	2,600	26,900	2%
United States	100	3,400	4,900	200	700	9,300	1%
Canada (non-Panel Areas)	**0**	**900**	**3,100**	**400**	**700**	**5,100**	**0%**
TOTAL RUN	**34,100**	**453,200**	**1,011,900**	**61,400**	**180,400**	**1,741,000**	**100%**
Total Catch in All Fisheries	4,100	132,400	396,800	10,100	30,000	573,400	33%
Adult Spawning Escapement *	29,900	188,700	564,400	22,100	10,300	815,500	47%
Jack Spawning Escapement	0	200	800	400	100	1,500	0%
Run-Size Adjustment	0	131,900	49,800	28,800	140,000	350,500	20%
Percentage of Total Run	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	
Total Catch in All Fisheries	12%	29%	39%	16%	17%	33%	
Spawning Escapement	88%	42%	56%	37%	6%	47%	
Run-Size Adjustment	0%	29%	5%	47%	78%	20%	

* Spawning escapement estimate for Cultus sockeye includes 159 individuals captured as brood stock.

Table 9. Catch, escapement, run-size adjustment, run size and exploitation rate estimates for Fraser River sockeye salmon by stock group in 2008.

Management Group / Stock Group	Catch	Adult Spawning Escapement	Run-size Adjustment	Abundance Adult	Abundance Jack [1]	Abundance Total	Portion of Run	Adult Exploitation Rate
Early Stuart	**4,100**	**29,900**	**0**	**34,000**	**0**	**34,100**	**2%**	**12%**
Early Summer	**132,400**	**188,700**	**131,900**	**453,000**	**200**	**453,200**	**26%**	**29%**
Chilliwack	4,600	67,800	10,400	82,800	0	82,800	5%	6%
Early Miscellaneous	90,700	82,500	69,300	242,500	200	242,700	14%	37%
Seymour/Scotch	11,000	5,000	15,100	31,200	0	31,200	2%	35%
Noth Thompson	23,700	16,600	34,100	74,300	0	74,300	4%	32%
Pitt	2,300	16,900	3,000	22,200	0	22,200	1%	10%
Summer	**396,800**	**564,400**	**49,800**	**1,011,100**	**800**	**1,011,900**	**58%**	**39%**
Chilko	180,700	249,900	14,700	445,300	700	446,000	26%	41%
Quesnel	25,300	7,100	35,100	67,500	0	67,500	4%	37%
Late Stuart/Stellako	190,800	307,500	0	498,300	100	498,400	29%	38%
Birkenhead	**10,100**	**22,100**	**28,800**	**61,000**	**400**	**61,400**	**4%**	**17%**
Late	**30,000**	**10,300**	**140,000**	**180,300**	**100**	**180,400**	**10%**	**17%**
Late Shuswap/Portage	6,400	300	11,400	18,000	0	18,000	1%	36%
Weaver/Cultus	16,800	3,100 [2]	100,300	120,200	100	120,300	7%	14%
Harrison	6,800	7,000	28,300	42,000	0	42,100	2%	16%
Total	**573,400**	**815,500**	**350,500**	**1,739,400**	**1,500**	**1,741,000**	**100%**	**33%**
Portion of Total Run	33%	47%	20%	100%	0%	100%		

1 Jack ratios were not estimated for fisheries. Estimates include only those jacks that were actually sampled and are therefore underestimates.

2 Spawing escapement estimate for Cultus sockeye includes 159 individuals captured as brood stock.

V. RUN SIZE, CATCH AND ESCAPEMENT

Table 8 provides an overview of run size by management group for Fraser River sockeye salmon. Included are estimates of catch, spawning escapement and run-size adjustment (RSA) [6]. Table 9 provides similar information, but with finer stock resolution. Figure 7 shows total sockeye abundance by year, while Figure 8 shows catch, escapement, RSAs and exploitation rate by year for a historical perspective. Details of commercial catch distributions of Fraser sockeye by area and gear in Canada and the U.S. are provided in Tables 10 and 11. Table 1 in Appendix I shows abundance, spawning escapement, RSA and catch of Fraser sockeye in Canadian and U.S. fisheries over the last four cycle years, while Table 2 in Appendix I shows a geographic breakdown of Canadian First Nations catches. Sockeye salmon escapements since 1938 are summarized by management group in Figure 10, and by stock for the last four cycle years in Table 3 in Appendix I.

[6] Run-size Adjustments (RSAs) are additions to the total return in cases when there is evidence that more fish returned than were accounted for in catch and escapement, e.g., evidence of en route mortality, incomplete spawning ground assessments. The focus of RSAs is on providing the best assessments of total returns, i.e., recruitment. Models that relate recruitment and spawning stock are used to develop both pre-season abundance forecasts and escapement policy. Staff work with the Fraser Technical Committee to provide recommendations to the Fraser Panel about how RSAs are assigned and corresponding best estimates of total return. PSC staff, Technical Committee members and DFO staff are collaborating in the development of a formal process and criteria for determining RSAs.

The total abundance of sockeye salmon in 2008 was 1,741,000 fish (Tables 8 and 9), or about 60% of the 50p pre-season forecast (Table 1) and 42% as large as in the brood year (2004, Figure 7). This was the smallest return on the 2008 cycle since 1928, although returns in 1944 and 1964 were only slightly higher. Since 1964, sockeye abundance on this cycle line has increased from a low of 1,825,000 fish to a peak abundance of 6,442,000 fish in 1992, stabilized within the 4,200,000 to 5,200,000 range between 1994-2004, and then declined to this year's level.

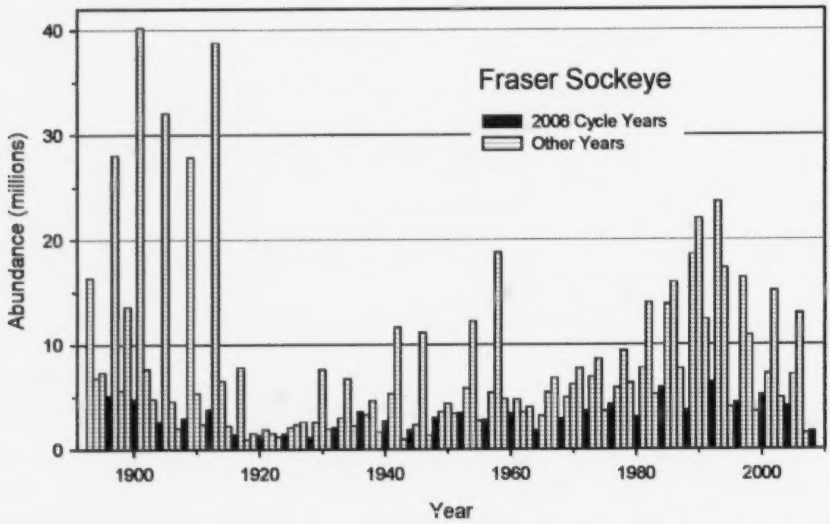

Figure 7. Total run size of Fraser River sockeye salmon between 1893-2008. Returns on the 2008 cycle are emphasized.

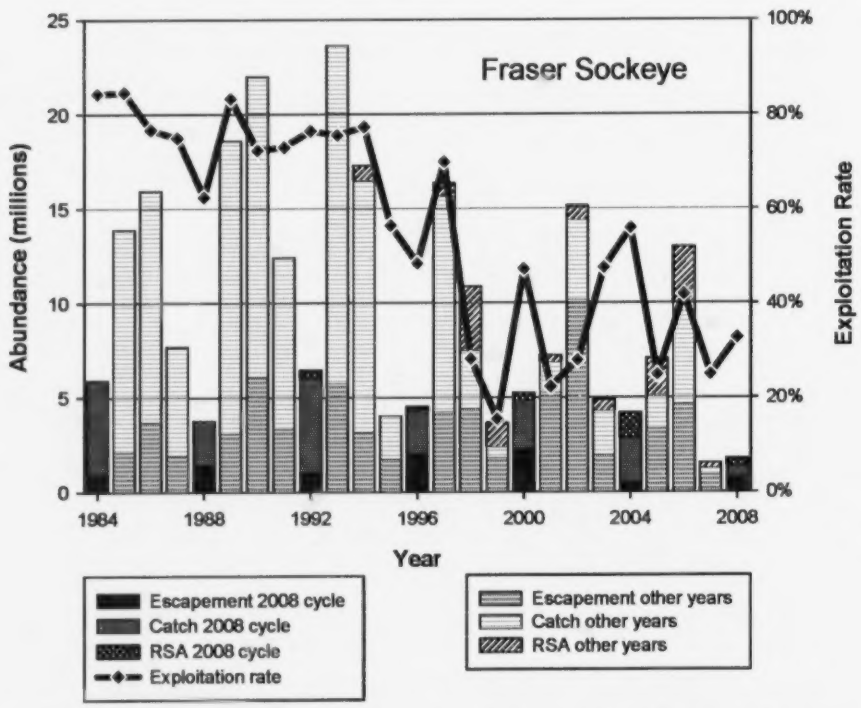

Figure 8. Total run size, catch, escapement, run-size adjustment and exploitation rate for Fraser River sockeye salmon between 1984-2008, with returns on the 2008 cycle emphasized.

Table 10. Canadian commercial catches of Fraser River sockeye salmon by gear type, license designation and statistical fishery area during the 2008 fishing season. Grey cells indicate fishery areas that are not part of a license area designation. *

Fishery	Purse Seine		Gillnet			Troll			
Areas	Area A	Area B	Area C	Area D	Area E	Area F	Area G	Area H	Total
Commercial	**0**	**12,200**	**0**	**3,500**	**0**	**0**	**0**	**400**	**16,200**
Panel Areas	**0**	**11,200**	**0**	**0**	**0**	**0**	**0**	**300**	**11,600**
20		11,200			0		0		11,200
17, 18, 29		0			0			300	300
121-124 *		0		0			0		0
Non-Panel Areas	**0**	**1,000**	**0**	**3,500**	**0**	**0**	**0**	**100**	**4,600**
1-10	0		0			0			0
11-16		1,000		3,500	0		0	100	4,600
124-127 *		0		0			0		0
First Nations Economic Opportunity and Demo Fisheries									**0**
Total Catch									**16,200**

* Catch in Area 124 is divided between Panel and Non-Panel Areas.

Table 11. U.S. commercial catches of Fraser River sockeye salmon by user group, gear type and statistical area during the 2008 fishing season. *

Areas	Troll	Purse Seine	Gillnet	Reefnet	Total
Panel Area (Washington) *	**0**	**11,400**	**33,900**	**2,700**	**48,000**
Treaty Indian *	**0**	**5,500**	**33,600**	**0**	**39,000**
4B, 5 and 6C	0	0	32,300	0	32,300
6 and 7	0	5,400	1,000	0	6,400
7A	0	100	300	0	300
All Citizen **	**0**	**6,000**	**400**	**2,700**	**9,000**
7	0	4,100	400	2,700	7,100
7A	0	1,800	0	0	1,800
Alaska (District 104) Catch					**1,600**
United States Total					**49,500**

* Estimates for Treaty-Indian fisheries are from the "TOCAS" database.

** Estimates for All Citizen fisheries are from the WDFW "LIFT" database.

The total return of Early Stuart sockeye was 34,000 adults (Tables 8 and 9), or 97% of the median pre-season forecast. Early Summer returns totalled 453,000 adult sockeye, 30% larger than the pre-season forecast. The abundance of Summer-run sockeye was 1,012,000 adults, or 56% of the pre-season forecast of 1,810,000 fish. For Birkenhead sockeye, the total abundance of 61,000 adults was only 19% of the pre-season forecast. The return of 180,000 Late-run adults was 48% of the median pre-season forecast of 374,000 fish.

The total catch of 573,000 fish was about 33% of the run (Tables 8 and 9). This exploitation rate is consistent with the trend towards lower exploitation rates observed since the mid 1990s (Figure 8) due to Canada's rebuilding strategy and conservation concerns for Late-run sockeye and other stocks. Of the total catch, 481,000 fish were caught in Canada, 51,000 fish in the U.S. and 41,000 fish in test fisheries (Table 8). Most of the Canadian catch was taken in First Nations fisheries (447,000 fish), with smaller portions in commercial (16,000 fish) and recreational fisheries (16,000 fish). Of the U.S. catch, Treaty Indian fishers caught 39,000 fish and All Citizen fishers caught 9,000 in commercial fisheries, 1,400 fish were caught in Treaty-Indian Ceremonial and Subsistence fisheries and 1,600 fish were caught in Alaska.

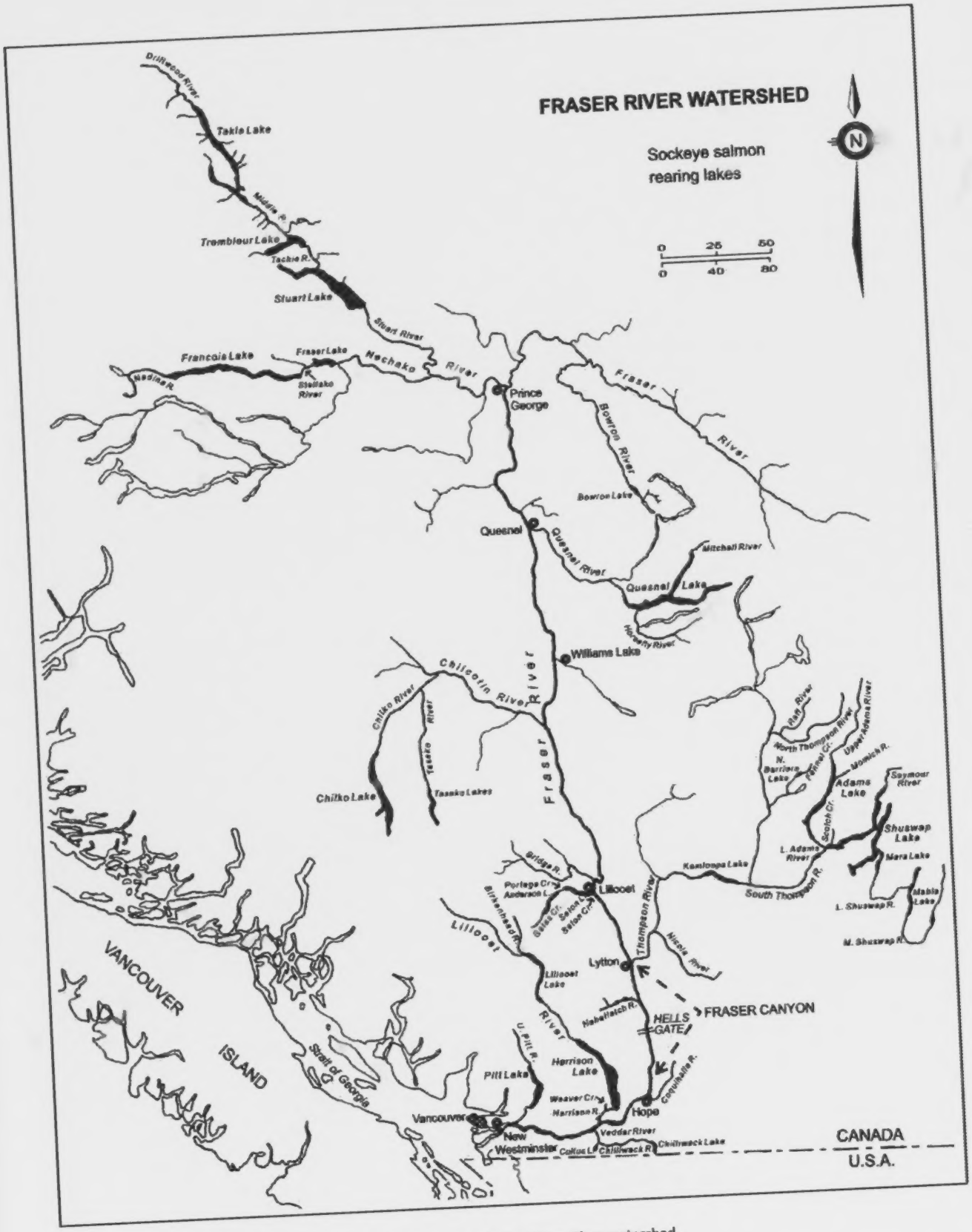

Figure 9. Sockeye salmon spawning grounds in the Fraser River watershed.

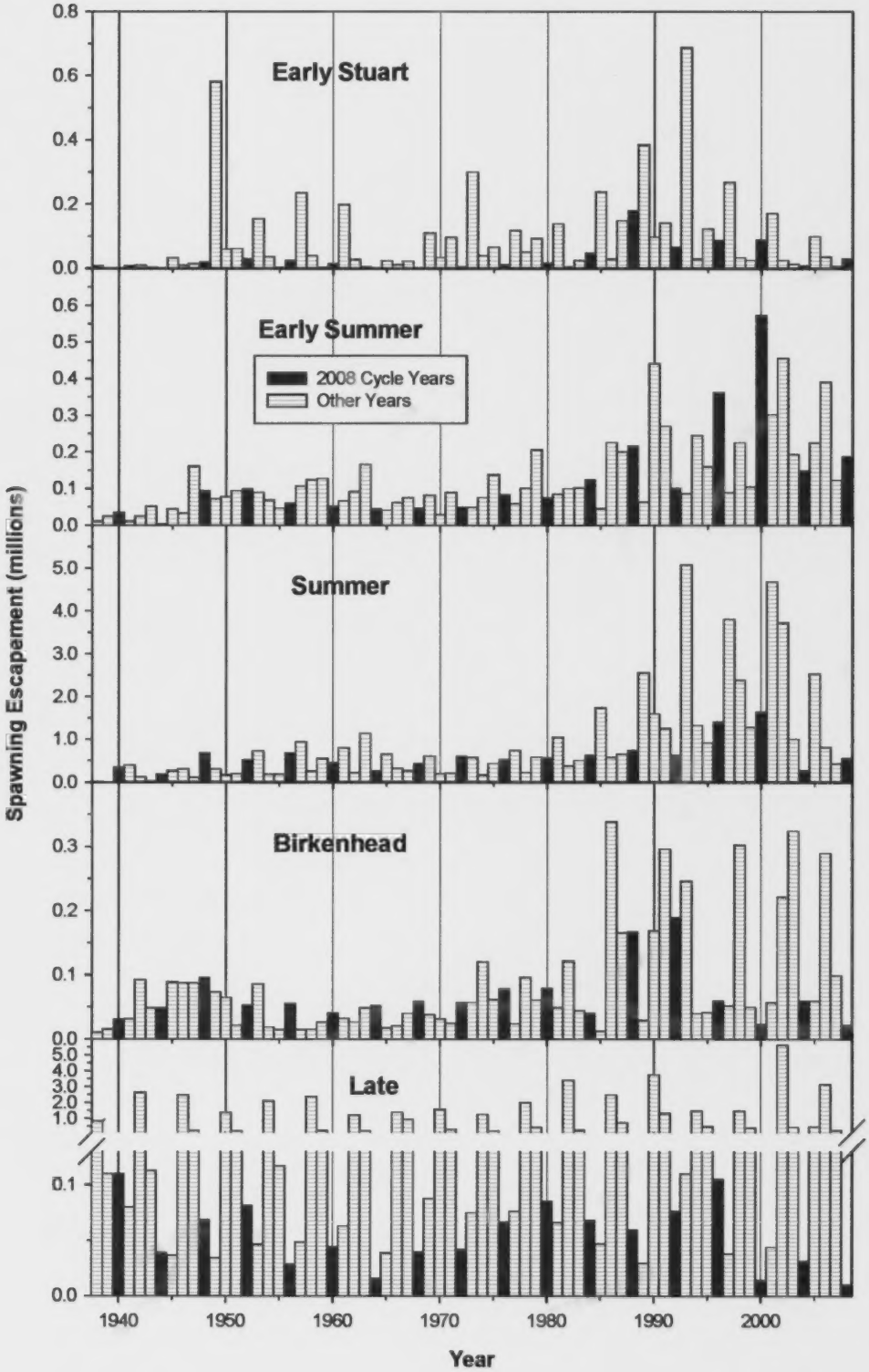

Figure 10. Adult spawning escapement of Fraser River sockeye salmon for each management group for 1938-2008, with escapements on the 2008 cycle emphasized.

DFO annually assesses the abundance of sockeye spawning populations in the Fraser watershed (Figure 9). In 2008, the near-final estimate of adult sockeye (primarily age 4 and age 5 fish) totalled 815,000 spawners, or 47% of the total run. This escapement was 55% greater than the brood year (2004) escapement of 524,000 adults. Many Early and Summer stocks experienced increased spawning escapements relative to the brood year, although this is in the context of extremely warm Fraser River temperatures and associated en-route losses in the brood year that resulted in lower than average escapements. For example, escapements to Chilko River and Lake totalled 250,000 fish, which is almost three times greater than the brood year escapement, but 47% below the recent (1992-2004) cycle year average of 584,000 fish. Among stocks with escapements similar to the brood year, the Quesnel system experienced low escapement for the second consecutive cycle year since a peak in 2000. Some stocks also saw severely reduced spawning populations compared to the brood year (e.g., Pitt, Birkenhead, Weaver and Late South Thompson). For example, only 164 Late South Thompson spawners were estimated on the spawning grounds, which was only 5% of the brood year escapement and reflects a run size that was well below pre-season forecasts.

Compared to previous escapements on this cycle line (Figure 10), the 2008 escapement was: (1) the second smallest since 1984, although three times larger than the brood year escapement for Early Stuart sockeye; (2) larger than the brood year but smaller than in 1996 and 2000 for Early Summer sockeye on this cycle; (3) larger than the brood year but the second lowest Summer-run escapement on this cycle since 1976; (4) the lowest Birkenhead escapement on any cycle since 2000; and (5) the lowest escapement of Late-run sockeye since at least 1938.

The extremely early arrival time and resulting extended freshwater residence times resulted in a female spawning success rate of only 64% for Fraser sockeye, much lower than the 98% success rate observed in the brood year (2004). While the total effective female spawning population of 274,000 fish was very close to the brood year population, it was the lowest since 1963.

The preliminary RSA estimate was 351,000 fish, or 20% of the total return. Early Summer and Late-run stocks were the largest contributors to this amount.

VI. ACHIEVEMENT OF OBJECTIVES

The mandate of the Fraser River Panel is to manage commercial fisheries in Panel Area waters to achieve a hierarchy of annual objectives. In order of importance, the objectives are to: (1) achieve spawning escapement targets for Fraser River sockeye and pink salmon that are set by Canada; (2) achieve targets for international sharing of the TAC as defined in the Treaty or by agreement among the Parties; and (3) achieve domestic catch allocation goals within each country. In addition, the Panel must consider conservation concerns for other stocks and species of salmon when planning and conducting fisheries. Panel management is evaluated after each season to determine whether the goals were achieved and to identify potential improvements in data collection programs, assessment methods and management techniques.

A. Escapement

The Panel's first task is to achieve spawning escapement targets as specified by Canada. Spawning escapement targets for Early Stuart, Early Summer and Summer-run sockeye were determined by applying Canada's spawning escapement plan to abundance estimates for each management group. The objective (as a percentage of abundance) established for Summer-run sockeye was also applied to Birkenhead sockeye. The nominal target for the Late run was established by a harvest rate limit of 20%, which left 80% of the run for spawning escapement and DBEs.

In-season management is based on targets for potential spawning escapement (PSE), which include spawning escapement targets plus MAs. Progress towards these targets during the fishing season is assessed by comparing PSE estimates (Mission escapement minus catch above Mission) to the targets. Mission (Figure 1) is used as the geographical reference point for this assessment

because estimates of daily escapement past Mission are available in-season. Furthermore, in-season monitoring of the progress toward PSE targets is more practical than attempting to directly monitor progress towards spawning escapement targets because of the large time lag between management actions and salmon arriving on the spawning grounds.

Based on final in-season PSE estimates, in-season PSE targets were exceeded for Early Summer (74% over, Table 12), Summer (17% over) and Birkenhead sockeye (74% over). Early Stuart sockeye fell short of the PSE target (8% under), while the target was nearly achieved for the Late run (1% under). One factor that contributed to the achievement of in-season PSE targets was early detection of the early arrival and weak returns of Fraser sockeye, and corresponding adjustments to management plans that resulted in severely constrained commercial fisheries. This is illustrated in Figure 11, which shows how the available harvest was reduced before high-impact fisheries could begin. This demonstrates how the Panel curtailed planned commercial fisheries when presented with in-season information that deviated from pre-season expectations. Additional factors that contributed to the achievement of PSE targets were window closures of Canadian First Nations fisheries in the river to protect Early Stuart sockeye, and fishery restrictions to protect Late-run stocks.

Table 12. Comparison of final in-season potential spawning escapement (PSE) target (i.e., spawning escapement target plus MA) and in-season PSE estimate (i.e., Mission escapement minus catch above Mission) for adult Fraser River sockeye salmon in 2008.

	Final	Potential Spawning Escapement					
Management Group	In-season Abundance Estimate	Spawning Escapement Target	Management Adjustment *	In-season PSE Target **	In-season PSE Estimate ***	Difference Fish	Difference %
Early Stuart	40,000	40,000	27,200	40,000	36,800	-3,200	-8%
Early Summer	450,000	180,000	7,600	187,600	326,200	138,600	74%
Summer	980,000	520,000	0	520,000	608,700	88,700	17%
Birkenhead	55,000	29,200	0	29,200	50,900	21,700	74%
Late	190,000	152,000	na	152,000	150,300	-1,700	-1%
Adult sockeye	1,715,000	921,200	34,800	928,800	1,173,100	244,100	26%

* Adjustment of spawning escapement targets to achieve spawning escapement goals. If the spawning escapement target + MA exceeds the total abundance, then the target equals the total abundance.

** Spawning escapement target + management adjustment.

*** Mission escapement estimate minus all catch above Mission.

Table 13. Comparison of post-season spawning escapement target and upriver escapement estimate for adult Fraser River sockeye salmon in 2008. Upriver estimates of sockeye spawners are from spawning ground enumeration programs (DFO).

	Post-season	Spawning Escapement			
Management Group	Abundance Estimate	Post-season Target	Upriver Estimate	Difference Fish	Difference %
Early Stuart	34,100	34,100	29,900	-4,200	-12%
Early Summer	453,200	181,300	188,700	7,400	4%
Summer	1,011,900	520,000	564,400	44,400	9%
Birkenhead	61,400	31,600	22,100	-9,500	-30%
Late	180,400	144,300	10,300	-134,000	-93%
Adult sockeye	1,741,000	911,300	815,500	-95,900	-11%

In addition to assessing the achievement of in-season PSE targets above, the achievement of post-season spawning escapement targets (Table 13) is assessed by comparing the assessed spawning ground populations to escapement targets derived by applying Canada's Spawning Escapement Plan to post-season run-size estimates. Post-season targets were achieved or nearly achieved for Early Stuart (12% under), Early Summer (4% over) and Summer (9% over) runs. For Early Stuart, the spawning escapement target was effectively the entire run. Thus, any catch or en route loss resulted in an escapement below the target. The spawning ground shortfall was due to

the run size being too low to achieve the target (even if the catch was zero) given the observed DBE (-16%) and the catch of 4,100 fish, primarily in First Nations and test fisheries (Table 8). Birkenhead sockeye are managed in-directly, by application of the Total Allowable Mortality percentage (TAM rule as a percentage of total run) as determined for the Summer run. The target for Birkenhead was not achieved (30% under), primarily because of a large unexpected DBE of 57%.

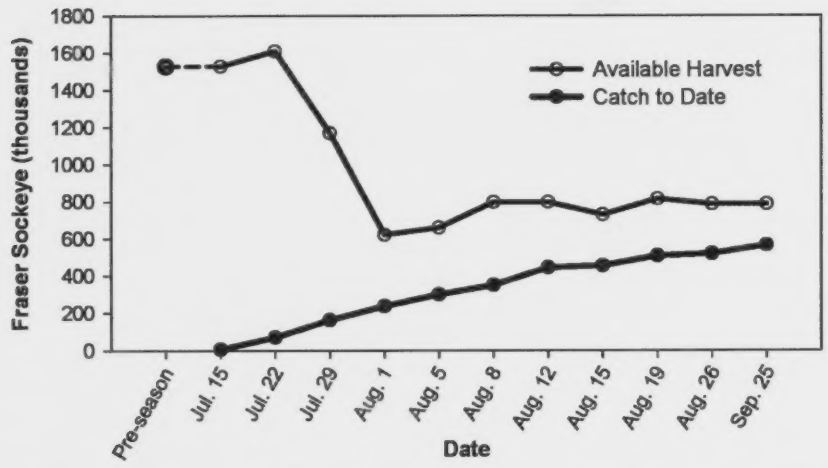

Figure 11. Comparison of available harvest and catch to date of Fraser River sockeye salmon in all fisheries in 2008. The available harvest represents the number of fish that are surplus to spawning escapement requirements and are calculated as run size minus spawning escapement target and management adjustment. It therefore includes fish that are available for catch in all commercial, recreational, First Nations and test fisheries.

Late-run sockeye were managed according to an exploitation rate limit of 20%. According to this measure, the total Late-run catch was 3% less than the limit (Table 14). The 20% exploitation rate limit left 80% of the run for spawning escapement and if necessary a run-size adjustment (RSA). If this entire amount is treated as a nominal escapement target (i.e., run * 80% = 180,000 fish * 80% = 144,000 spawners, Table 13), then the escapement of 10,000 fish was 93% below the target. In this context the major cause of the 134,000 fish escapement shortfall was that the run size was too small to achieve the target given the estimated RSA of -78% (Table 8). To overcome this magnitude of RSA and achieve the spawning target of 144,000 fish, a Late-run abundance in excess of 600,000 fish would have been necessary.

Table 14. Achievement of the 20% exploitation rate limit for Late-run sockeye in 2008.

Item	% of Run	Fish
Late-run Abundance (adults, post-season)	100%	180,300
Exploitation rate limit	20%	36,100
Catch	17%	30,000
Deviation	-3%	-6,100

B. International Allocation

The Panel's second priority is to achieve the goals for international allocation of the TAC. In accordance with Annex IV, Chapter 4 of the Pacific Salmon Treaty, calculation of the U.S. share of the TAC is based on the run size and deductions that were in effect on the date that regulatory

control of U.S. waters was relinquished by the Panel (October 4). The international TAC at that time was 345,000 Fraser sockeye (Table 15 and Appendix I, Table 4).

Including the Washington share of the TAC (16.5%) and a payback of 3,400 fish owed by the U.S. for a catch overage in 2007, the net U.S. share was 53,600 fish. The U.S. agreed to pay back the full amount owed (3,400 fish) even though it exceeded 5% of the Washington share of the TAC. Subtraction of the Washington catch of 49,400 fish leaves a U.S. catch shortfall of 4,200 Fraser sockeye.

Similarly, Canada's share of the TAC at the time of relinquishment plus the AFE yielded a total Canadian share of 692,000 fish. Canada's catch was 481,000 fish, leaving a catch shortfall of 211,000 Fraser sockeye.

Table 15. Calculation of the total allowable catch (TAC) for Fraser River sockeye salmon and the achievement of international shares of the TAC in 2008. These calculations use the in-season estimates of run size, spawning escapement target, management adjustment and test fishing catch at the time the Panel relinquished control of the last U.S. Panel Area (October 4) in accordance with Annex IV of the Treaty and the February 15, 2008 Commission Guidance (Appendix C).

		Sockeye	
TOTAL ALLOWABLE CATCH			
In-season Total Run Size		**1,715,000**	
Deductions		**1,397,300**	
In-season Spawning Escapement Target		921,200	
In-season Management Adjustment		34,800	
Aboriginal Fishery Exemption (AFE)		400,000	
In-season Test Fishing Catch		41,300	
Total Allowable Catch	*1, 2*	**345,300**	
UNITED STATES			
Washington Share		**53,600**	
Washington Share of TAC	*1, 3*	57,000	16.5%
Payback	*3*	-3,400	
Washington Catch		**49,400**	
Deviation		**4,200**	
In-season Alaska Catch Estimate		0	
CANADA			
Canadian Share of TAC + U.S. Payback + AFE		**691,800**	
Canadian Catch excluding ESSR Catch		**481,100**	
Deviation		**210,600**	

1 TAC and Washington sockeye share according to Annex IV of the Pacific Salmon Treaty and Feb. 15, 2008, Commission Guidance.

2 TAC may not equal the total run minus total deductions shown due to adjustments required when the run size of individual management groups is less than the nominal deductions. A more detailed TAC calculation showing these intermediate calculations is shown in Appendix I.

3 United States share according to revised Annex IV of the Pacific Salmon Treaty: Sockeye: 16.5% of the TAC - payback (maximum 5% of share).

C. Domestic Allocation

The third priority of the Panel is to achieve domestic allocation goals as specified by the Parties. While the Panel manages all commercial fisheries directed at Fraser River sockeye and pink salmon in Panel Area waters (Figure 1), Canada has sole responsibility for regulating several of its fisheries including commercial net and troll fisheries in non-Panel areas such as Johnstone Strait, and First Nations and recreational fisheries in all fishing areas. Thus, achievement of Canadian domestic allocation goals requires coordination between Panel and non-Panel regulatory actions.

With respect to domestic allocation within Washington state, Treaty Indian fishers were 5,200 fish over and All Citizen fishers were 9,400 fish under their respective allocations (Table 16). In Canada, Area B purse seines were 4,500 fish over, Area D gillnets were 500 fish over, Area E gillnets were 3,500 under and Area H trollers were 1,500 under their respective allocations (Table 17). The catch of Fraser sockeye in Canadian First Nations fisheries totalled 447,000 fish compared to an in-season expected catch of 691,000 fish.

Table 16. Achievement of domestic catch allocation objectives for Fraser River sockeye salmon in Washington in 2008.

	Actual Catch		Share of TAC		
User Category	Fish	%	Fish	%	Deviation
Washington Total	**49,400**	**100.0%**	**53,600**	**100.0%**	**-4,200**
Treaty Indian *	40,400	81.8%	35,200	65.7%	5,200
All Citizen **	9,000	18.2%	18,400	34.3%	-9,400

* Treaty Indian catch includes commercial and ceremonial catches.
TI share = (67.7% of U.S. share of TAC) - (100% of U.S. payback).

** All Citizen catch includes commercial and recreational catches.
NI share = (32.3% of U.S. share of TAC) - (0% of U.S. payback).

Table 17. Achievement of domestic commercial catch allocation objectives for Fraser River sockeye salmon in Canada. in 2008.

	Actual Catch		Catch Goals		
Gear License Area	Fish	%	Fish	%	Deviation
Purse Seine	**12,200**	**75.8%**	**7,700**	**47.5%**	**4,500**
B Southern	12,200	75.8%	7,700	47.5%	4,500
Gillnet	**3,500**	**21.7%**	**6,500**	**40.5%**	**-3,000**
D Johnstone Strait	3,500	21.7%	3,000	18.5%	500
E Fraser River	0	0.0%	3,500	22.0%	-3,500
Troll	**400**	**2.5%**	**1,900**	**12.0%**	**-1,500**
H Inside	400	2.5%	1,900	12.0%	-1,500
Total	**16,100**	**100.0%**	**16,100**	**100.0%**	**0**

D. Conservation of Other Stocks and Species

Catches of non-target stocks and species in Panel Area fisheries directed at Fraser River sockeye salmon were small in 2008, largely due to the lack of sockeye-directed commercial fisheries (Table 18). By-catches of non-Fraser salmon in commercial net fisheries regulated by the Fraser River Panel totalled zero sockeye and 700 pink salmon. Catches of other Fraser and non-Fraser salmon included 4,400 chinook, 180 coho, 240 chum and 380 steelhead.

Table 18. Catch of non-Fraser sockeye and pink salmon and of other salmon species in commercial fisheries regulated by the Fraser River Panel in 2008.

	Non-Fraser		Fraser and Non-Fraser			
Area and Gear	Sockeye	Pink	Chinook	Coho	Chum	Steelhead
United States *	**0**	**660**	**4,400**	**180**	**240**	**380**
Areas 4B, 5 and 6C Net	0	610	4,400	180	240	380
Areas 6, 7 and 7A Net	0	50	20	0	0	0
Canada	**0**	**40**	**0**	**0**	**0**	**0**
Area 20 Net	0	40	0	0	0	0
Area 29 Net	0	0	0	0	0	0
Total	**0**	**700**	**4,400**	**180**	**240**	**380**

* Estimates for All Citizen fisheries are from the WDFW "LIFT" database and for Treaty-Indian fisheries are from the "TOCAS" database.

VII. ALLOCATION STATUS

By Panel agreement, there are no paybacks of either Fraser sockeye or pink salmon to carry forward to 2009 (Table 19).

Table 19. Allocation status of Fraser River sockeye salmon for 1999-2008. After 2008, no paybacks were due for Fraser sockeye salmon.

	Fraser Sockeye									
	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
TOTAL ALLOWABLE CATCH										
Total Run Size	3,643,000	5,217,000	7,213,000	15,312,000	5,408,000	4,438,000	8,770,000	8,715,000	1,428,000	2,352,000
Escapement and other deductions	3,438,000	3,198,000	6,132,000	9,568,000	3,159,000	3,663,000	6,124,000	6,457,000	1,428,000	1,625,000
Total Allowable Catch:	205,000	2,019,000	1,081,000	5,744,000	2,249,000	775,000	2,646,000	2,258,000	0	727,000
UNITED STATES										
Washington Catch	20,000	494,000	241,000	449,000	244,000	197,000	201,000	708,000	3,400	50,000
Washington Share (exclds paybac	46,000	412,000	241,000	496,000	371,000	128,000	437,000	373,000	0	120,000
Deviation:	-26,000	82,000	0	-47,000	-127,000	69,000	-236,000	335,000	3,400	-70,000
Cumulative Allocation Status:	**-26,000**	**56,000**	**56,000**	**9,000**	**0 ****	**0 ****	**0 ****	**0 ****	**3,400**	**0 ****
CANADA										
Catch (excluding ESSR)	416,000	1,870,000	1,197,000	3,508,000	1,918,000	2,013,000	1,143,000	4,565,000	197,000	481,000
Share + Aboriginal Exemption	390,000	1,952,000	1,197,000	n/a	2,278,000	1,047,000	2,609,000	2,285,000	197,000	1,007,000
Deviation:	26,000	-82,000	0	n/a	-360,000	966,000	-1,466,000	2,280,000	0	-526,000

* Washington share of the TAC according to Annex IV of the Pacific Salmon Treaty:

1999: Shall not exceed 22.4% for Fraser sockeye and 25.7% for Fraser pinks.

2000: Shall not exceed 20.4% for Fraser sockeye.

2001: Washington share equals Washington catch for Fraser sockeye and pink salmon, by agreement between the Parties on June 12, 2002.

2002: By a Feb. 12-13, 2003 Panel agreement, the Washington share equals the Washington catch plus the maximum payback (449,000 +47,000 =496,000). By agreement, no paybacks generated for 2003.

2003: Shall not exceed 16.5% for Fraser sockeye minus the payback, and 25.7% for Fraser pinks plus the payback. By agreement, no paybacks generated for 2004.

2004: Shall not exceed 16.5% for Fraser sockeye. By agreement, no paybacks generated for 2005.

2005: Shall not exceed 16.5% for Fraser sockeye and 25.7% for Fraser pinks. Panel interpretation of Feb. 18, 2005 Commission Guidance, item 1c(ii), was that no paybacks resulted from catch overages or underages in 2005 and so no paybacks generated for 2006.

2006: Shall not exceed 16.5% for Fraser sockeye and 25.7% for Fraser pinks. By agreement (Feb. 14, 2008), no paybacks generated for 2007.

2007: Shall not exceed 16.5% for Fraser sockeye and 25.7% for Fraser pinks. The U.S. catch of 3,400 Fraser sockeye were by-catch in pink-salmon directed fisheries and were landed as ceremonial catch.

2008: Shall not exceed 16.5% for Fraser sockeye. By Panel agreement (Sep. 25, 2008), no paybacks resulted from the 2008 season.

** By Panel agreement, no paybacks are to be carried forward.

VIII. APPENDICES

APPENDIX A: GLOSSARY OF TERMS AND ABBREVIATIONS

Bayesian inference: Statistical inference which allows pre-season forecasts of run size, diversion rate and migration timing to be updated with in-season observations. Uncertainty in the estimates decreases as more in-season data become available. The name "Bayesian" comes from the frequent use of Bayes' theorem in the inference process.

Difference between estimates (DBE): Difference between estimates of potential spawning escapement (PSE) and spawning escapement. Sources for DBEs include en route mortality and errors (bias and imprecision) introduced through the estimates of Mission escapement, spawning ground escapement, First Nations and recreational catches above Mission, and stock composition. Historical DBE values are used to generate Management Adjustment (MA) models, which use estimates of migration timing and river conditions (flow level and temperature) to predict the DBEs likely to be observed in the current year. DBEs may be represented as a number of fish or a percentage of the potential spawning escapement, and are related to pMAs through the formula: pDBE = ((1/(1+pMA))-1, where pDBE is the %DBE represented as a proportion.

Demonstration (Demo) fishery: Commercial Fraser River First Nations fishery in the BC Interior (BCI).

Diversion rate: Proportion of the salmon run that migrates through Johnstone Strait (northern approach) as opposed to Juan de Fuca Strait (southern approach). Estimates may be in weekly time steps or a value for the entire migration.

Economic Opportunity (EO) fishery: Commercial Fraser River First Nations fishery in the lower Fraser River or Strait of Georgia.

Fishery Simulation Model: A pre-season model that allows the Panel to evaluate the impacts of various fishery options on the achievement of management objectives, given such pre-season expectations as abundance, migration timing, diversion rate, catch and escapement objectives, and management adjustments by stock group.

Gross escapement: In-season estimates are calculated by summing the escapement past Mission plus First Nations, recreational and ESSR catches in the Fraser River below Mission. Post-season estimates are the sum of spawning ground abundances, run-size adjustments (RSAs), and catches in First Nations (FSC and EO), recreational and ESSR fisheries in the Fraser River watershed.

Management Adjustment (MA): Additional fish added to an escapement target for the purpose of increasing the likelihood of achieving the escapement target. MAs are estimated by MA models, which use estimates of migration timing and river conditions to predict a proportional adjustment (pMA) to the spawning escapement target. The pMA is then multiplied by the spawning escapement target to predict the numerical MA that is likely required to achieve the target. MAs are calculated bi-weekly during the fishing season using observed and predicted river conditions. DBEs are related to pMAs through the formula: pMA = ((1/(1+pDBE))-1, where pDBE is the %DBE represented as a proportion.

Management group or Run-timing group: Aggregates of Fraser River sockeye salmon stocks that are used in Fraser Panel management, i.e., Early Stuart, Early Summer, Summer, Birkenhead and Late-run groups.

Migration date or 50% date: Dates when half of the total run would have passed a certain geographical location, if it is assumed that all fish migrated via that route.

> **Area 20 date**: An index of marine migration timing, assuming the entire run migrated through Canadian Fishery Management Area 20 in Juan de Fuca Strait.
>
> **Mission date**: An index of in-river migration timing, it is the date when 50% of the total Mission escapement (usually identified by individual stock or stock group) is estimated to have passed Mission.

Reconstructed Mission date: An index of in-river migration timing based on the reconstructed run to Mission (Mission escapements plus catches seaward of Mission). Such reconstructed Mission dates are generally not available for Late-run stocks for which a portion of the run is expected to delay prior to entering the Fraser River.

Mission escapement or Mission passage: PSC estimates of the daily number of fish that migrate upstream past the hydroacoustic field station at Mission, B.C. Mission escapement is primarily estimated by hydroacoustic methods, but at times (early and late in the season) is supplemented by expanded CPUE estimates derived from in-river test fisheries.

Potential Spawning Escapement (PSE)

Potential spawning escapement target: In-season target for PSE by management group, where the PSE is the sum of the spawning escapement target plus the management adjustment (MA). May also be called the "Adjusted Spawning Escapement target". The management objective is to achieve the PSE target in-season as measured by the potential spawning escapement.

Potential spawning escapement: Mission escapement estimate minus First Nations and recreational catches above Mission. If there were no en route mortalities or estimation errors in Mission escapement, up-river catches, spawning escapement or stock identification, the potential spawning escapement would in theory equal the estimated spawning populations.

Run size: Total abundance or total return of a stock, management group or entire population of Fraser River sockeye or pink salmon.

Run-size adjustment (RSA): An amount often equated to en route loss that is added to estimates of catch and spawning escapement to provide the best estimate of total run size. The assessment of RSAs is based on DBE estimates and other information.

Spawning escapement

Spawning escapement or Net escapement: Spawning abundance of sockeye salmon as estimated through programs conducted on the spawning grounds, or projected from other data when such programs are incomplete (e.g., Quesnel spawners in 2002). Estimates of spawner abundances do not include losses from pre-spawn mortality on the spawning grounds, however, pre-spawn mortality is accounted for in estimates of Effective Female spawners.

Spawning escapement target: Target for total adult spawning escapement for each spawning population as defined each year by Canada's Spawning Escapement Plan.

Total Allowable Mortality rule (TAM rule): For each Fraser sockeye management group at different run sizes, Canada's Spawning Escapement Plan specifies the total allowable mortality from all sources, including fishery removals (catch) and en route mortality (represented by the Management Adjustment).

List of abbreviations

ADF&G: Alaska Department of Fish and Game	FSC: "Food, social and ceremonial", as relates to First Nations fisheries
AFE: Aboriginal Fishery Exemption	GSI: Genetic Stock Identification
BC: Province of British Columbia	JS: Johnstone Strait
DBE: Difference between estimates	LGL: A biological consulting company
CPUE: Catch per Unit of Effort	MA: Management Adjustment
DFO: Fisheries and Oceans Canada	MLP: Mandatory Landing Program
DIDSON: Dual-frequency IDentification SONar	M-R: Mark-recapture
EO: Economic Opportunity	pMA: Proportional Management Adjustment
ESSR: Terminal harvest of Weaver Creek sockeye that are "Excess Salmon to Spawning Requirements"	PSC: Pacific Salmon Commission
	RSA: Run-size Adjustment
	SET: Spawning Escapement Target
FRP: Fraser River Panel	TAC: Total Allowable Catch
FRPTC: Fraser River Panel Technical Committee	TAM: Total Allowable Mortality
	WDFW: Washington Department of Fish and Wildlife

APPENDIX B: 2008 PRE-SEASON FORECASTS AND SPAWNING ESCAPEMENT TARGETS FOR FRASER RIVER SOCKEYE SALMON

Table 1. Pre-season forecasts of Fraser River sockeye salmon abundance in 2008. (Provided to the Panel by Fisheries and Oceans Canada) [7]

Table 2. Pre-season forecasts for 2008 by stock/timing group and probability.

Sockeye stock/timing group	Forecast model[b]	Mean Run Size[c] all cycles	Mean Run Size[c] 2008 cycle	Probability of Achieving Specified Run Sizes[a] 0.1	0.25	0.5	0.75	0.9
Early Stuart	fry	335,000	182,000	73,000	49,000	35,000	24,000	17,000
Early Summer		-	-	932,000	563,000	349,000	216,000	136,000
(total excluding miscellaneous)		*(499,000)*	*(538,000)*	*(702,000)*	*(444,000)*	*(288,000)*	*(185,000)*	*(120,000)*
Bowron	Ricker-pi	23,000	26,000	8,000	6,000	5,000	3,000	2,000
Fennell	power	28,000	41,000	37,000	25,000	17,000	11,000	7,000
Gates	power	65,000	149,000	148,000	97,000	63,000	38,000	25,000
Nadina	fry	80,000	129,000	268,000	168,000	103,000	59,000	35,000
Pitt	power	61,000	65,000	91,000	73,000	59,000	52,000	39,000
Raft	power	32,000	64,000	91,000	51,000	27,000	14,000	8,000
Scotch	power	63,000	16,000	19,000	10,000	5,000	3,000	1,000
Seymour	Ricker-cyc	147,000	48,000	20,000	14,000	9,000	5,000	3,000
Misc[d]	R/S	-	-	136,000	72,000	37,000	20,000	10,000
Misc[e]	R/S	-	-	50,000	26,000	14,000	7,000	4,000
Misc[f]	avg escp	-	-	44,000	21,000	10,000	4,000	2,000
Summer		5,877,000	2,882,000	4,324,000	2,729,000	1,810,000	1,182,000	822,000
Chilko	smolt	1,760,000	1,804,000	1,783,000	1,230,000	885,000	596,000	433,000
Late Stuart	power	834,000	323,000	1,450,000	714,000	355,000	177,000	95,000
Quesnel	power	2,556,000	90,000	255,000	163,000	93,000	48,000	27,000
Stellako	Ricker	527,000	665,000	836,000	622,000	477,000	361,000	267,000
Late		-	-	1,728,000	1,139,000	705,000	432,000	283,000
(total excluding miscellaneous)		*(3,172,000)*	*(788,000)*	*(1,435,000)*	*(938,000)*	*(610,000)*	*(408,000)*	*(268,000)*
Cultus	smolt-jack	19,000	6,000	14,000	9,000	5,000	3,000	2,000
Harrison[h]	TSA	47,000	19,000	233,000	110,000	47,000	21,000	10,000
Late Shuswap	Larkin	2,133,000	39,000	49,000	26,000	15,000	7,000	3,000
Portage	power	58,000	24,000	49,000	27,000	15,000	7,000	4,000
Weaver	fry	432,000	405,000	629,000	434,000	290,000	193,000	126,000
Birkenhead	power	483,000	295,000	461,000	332,000	238,000	169,000	123,000
Misc. Shuswap[g]	R/S	-	-	6,000	3,000	2,000	1,000	1,000
Misc. non-Shuswap[g]	R/S	-	-	287,000	198,000	93,000	31,000	14,000
TOTAL		-	-	7,057,000	4,480,000	2,899,000	1,854,000	1,258,000
(TOTAL excluding miscellaneous)		*(9,683,000)*	*(4,390,000)*	*(5,534,000)*	*(4,181,000)*	*(2,743,000)*	*(1,791,000)*	*(1,227,000)*

[a] probability that the actual run size will exceed the specified projection

[b] see Cass *et al.* 2006 for model descriptions

(see document cited as footnote 7 in this report for Cass reference)

[c] sockeye: 1980-2005 (excluding miscellaneous stocks)

[d] unforecasted miscellaneous Early Summer stocks (Early Shuswap stocks and N.Thompson mainstem); return timing most similar to Scotch & Seymour).

[e] unforecasted miscellaneous Early Summer stocks (N. Thomson tributaries, Nahatlatch, etc.; return timing most similar to Fennell/Bowron/Nadina).

[f] Chilliwack Lake and Dolly Varden Creek; return timing most similar to Early Stuart.

[g] unforecasted miscellaneous Late stocks; note that the true late component made up a very small component of the Misc. non-Shu (<200 at 50% probability level)

[h] Harrison River brood year escapement (three year olds) in 2005 was ~200,000. Given this is considerably greater than the long term average (1980-2002: 4,300) and exceeds the SR data series, the best performing naïve models was used (TSA).

Model definitions: R1C (recruitment like last generation); TSA (time series average); Ricker-pi (Ricker function with Pine Island SST covariate); Ricker-cyc (Ricker function using cycle line data only).

[7] DFO, 2008. Pre-season run size forecasts for Fraser River sockeye salmon in 2008. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2007/049.

Table 2. Fraser River sockeye salmon escapement plan (in thousands of fish) for 2008. (Provided to the Panel by Fisheries and Oceans Canada in March 2008).

Draft 2008 Fraser River sockeye escapement plan (In 1000s of fish; at mid-point of forecast range)

Stock Group	Run Size Estimate of forecasted stocks	Run Size Reference Points		Total Mortality Rate Guidelines	Total Allowable Mortality at Run Size	Escapement Target at Run Size	Management Adjustment (a)		Exploitation Rate after MA	Cycle year adult escapement estimates				
										1988	1992	1996	2000	2004
Early Stuart	35	- 108 270	108 270	0% 0 - 60% 60%	0%	35	69%	24	0%	180	66	88	90	9
Early Summer	349	- 145 364	145 364	0% 0 - 60% 60%	58%	145	41%	59	41%	218	102	363	574	157
Summer	1,810	- 520 1,300	520 1,300	0% 0 - 60% 60%	60%	724	5%	36	58%	745	635	1,412	1,650	272
Birkenhead and Birkenhead-type Lates (b)	331			0% 0 - 60% 60%	60%	132			60%	167	186	56	14	38
True-Late (excl. Birk. Type)	374	- 503 1,005	503 1,005	20% 20 - 60% 60%	20%	299			20%	61	80	143	25	54
Cultus	5								20%	1	1	2	1	0
Sockeye Totals	2,899 *Est. Return*					1,336		120		1,371	1,070	2,064	2,354	529

a) Management adjustments (MAs) are added to the escapement targets to correct for the actual differences between Mission and upstream abundance estimates over all years. This approach makes no prior assumption about environmental conditions because we don't yet know whether conditions will be favourable or unfavourable in 2008. We expect that the MAs will be revised to take into account an environmental conditions during the inseason management period.

b) Birkenhead type Lates include returns in the miscellaneous non-Shuswap component of the forecast returning to natal spawning areas in the Harrison-Lillooet systems (excluding Harrison and Weaver).

APPENDIX C: COMMISSION GUIDANCE TO THE FRASER RIVER PANEL FOR 2008

February 15, 2008

Commission Guidance to the Fraser River Panel

The purpose of this document is to provide Commission direction to the Fraser River Panel with respect to implementation of Paragraph 8 of Chapter 4, Annex IV of the Pacific Salmon Treaty.

1. Annually, as determined by post-season catch estimates, the U.S. share shall be adjusted for harvest overages and underages as follows:

   (a) The U.S. share shall be adjusted in the amount of any harvest overage or underage of the same species from the previous year or years as provided in subparagraphs 1(b) and 1(c), below. In making such adjustment, the U.S. current year share will not be reduced by more than 5 percent nor increased by more than 15 percent because of the adjustment, unless otherwise agreed. The Fraser River Panel shall attempt to fully implement any adjustments to the U.S. share by the expiration of this Chapter. Any remaining balance from the harvest overage or underage shall be incorporated in the subsequent year's allocation. Any residual overage or underage remaining at the last year of this Chapter shall be carried forward into the next Chapter period.

   (b) The U.S. share will be adjusted to account for management imprecision in U.S. fisheries subject to the limitations prescribed in subparagraph 1(c). Additionally, the U.S. share will be adjusted for underages which occur as a result of Canada directly impeding the U.S. from pursuing its in-season share of the TAC. This latter circumstance will be noted in-season by the Panel including the effect Canada's catch had on impeding the U.S. pursuit of its in-season share, and will be compensated for as an underage pursuant to paragraph 1(a).

   (c) The U.S. share will not be adjusted:

      (i) for underages which occur because the U.S. fishery failed to deploy sufficient effort;

      (ii) for underages which occur because too few fish were available to the U.S. fishery due to migration patterns (e.g., diversion rates) or harvesting constraints for intermingled stocks or species; or

      (iii) for that portion of an underage resulting from an increase in the estimated TAC identified after the year's fishery has ended but which would not have been available due to harvest constraints for intermingled stocks or species.

      (iv) for an overage resulting from TAC reductions after the scheduling of the last U.S. fishery of the season.

2. The Fraser River Panel shall develop agreed procedures for implementing this guidance as part of its preseason planning process.

APPENDIX D: 2008 FRASER RIVER PANEL MANAGEMENT PLAN PRINCIPLES AND CONSTRAINTS (final July 12, 2008)

1. Fisheries and Oceans Canada (DFO) have provided the Panel with run-size forecasts for Fraser River sockeye salmon by run timing group. For pre-season planning purposes, the Panel used the 50% probability (p) levels of abundance. There is a 50% probability that the Fraser sockeye salmon return will reach or exceed 2,899,000 fish.

2. The Panel's first priority for 2008 is to achieve conservation objectives for all stocks, including Late-run sockeye[8] objectives as indicated in the document, "Guidelines for Pre-season Fraser Sockeye Fishing Plans to Address Late-Run Concerns".

3. The Panel has adopted a management approach for Late-run sockeye that presumes that similar to recent years, Late-run sockeye will enter the Fraser River early and a significant proportion will not survive to spawn. The Panel may update its assumptions about Late-run upstream timing and mortality based on advice from PSC staff, during the in-season management period.

4. TAC and international shares will be calculated according to the February 15, 2008 Commission Guidance and the 2005 revised Annex IV, Chapter 4, of the Pacific Salmon Treaty, which limits the United States harvest (in Washington State) to 16.5% of the total allowable catch (TAC) of Fraser River sockeye salmon. Based upon the 50% p levels of abundance, for the purposes of computing TAC by stock management grouping in 2008, the Panel agreed that the Fraser River Aboriginal Exemptions were as follows: Early Stuart sockeye, 0 fish, Early Summer sockeye, 100,400 fish; Summer-run sockeye, 276,700 fish; Birkenhead sockeye, 5,600 fish; and Late-run sockeye, 17,300 fish. There is no available harvest of Early Stuart sockeye at the 50% p level forecast of abundance. As per Fraser Panel agreement, for the 2008 season the United States owes a payback of 3,400 Fraser sockeye as a result of the 2007 season.

5. For planning fisheries, the Panel has adopted 50% probability level forecasts for Early Stuart (35,000 fish), Early Summer-run (349,000 fish), Summer-run (1,810,000 fish), Birkenhead[9] (331,000) and Late-run sockeye (374,000). When sufficient information is available in-season, the Panel will update run size estimates of Fraser River sockeye salmon, as appropriate.

Regulations

i.) If the abundance of Early Summer-run sockeye salmon is tracking at approximately the 50% probability level (349,000 fish) and the abundance of Summer-run sockeye salmon is tracking at approximately the 50% probability level (1,810,000 fish) and the runs arrive at or near expected dates, low impact fisheries would be expected to commence the week of July 20 – July 26 in Panel Waters. If the return abundances of Early Summer-run and Summer-run sockeye vary from the 50% probability level forecast, this could change the start dates and duration of fisheries.

ii.) The Parties' conservation concerns for other species and stocks will be taken into account throughout the 2008 management season.

[8] Late-run here refers to the Late-run timing group, excluding Birkenhead and a few minor miscellaneous sockeye stocks.

[9] Birkenhead includes Big Silver and other miscellaneous stocks.

APPENDIX E: GUIDELINES FOR PRE-SEASON FRASER SOCKEYE FISHING PLANS TO ADDRESS LATE-RUN [10] CONCERNS (final July 12, 2008)

The 2008 cycle is the first off-line cycle for Adams River sockeye, and "true" Late-run sockeye have historically experienced small returns on this cycle line relative to Summer-run sockeye, with the Weaver Creek stock group the predominant Late-run stock. The total forecast for Late-run sockeye in 2008 (374,000 fish at the 50% p level) is approximately 25% lower than average for this cycle. There is special concern for Cultus sockeye for which recovery plans are being implemented by Canada to ensure this stock's long-term viability. The brood year (2004) escapement of Cultus sockeye was only a small fraction of the cycle year average, however a hatchery supplementation program of fry and smolts into the Cultus system increased the number of out-migrating smolts substantially. A co-ordinated approach to management will be developed that reflects both Parties sharing the burden of conservation of Late-run sockeye.

ASSUMPTIONS

1. For fisheries planning purposes, we assumed that Late-run sockeye will continue their post-1995 early upstream migration behaviour. Given pre-season assumptions about marine timing and recent delay behaviour, the median upstream migration date for Late-run sockeye is expected to occur during the 2nd or 3rd week of August. Given this timing and based on the 50p forecast level of abundance (374,000 fish), the allowable exploitation rate is 20%.
2. Estimates of abundance, migration timing, etc., for Summer-run and Late-run sockeye will be provided in-season, however, the timeliness of Late-run updates will depend on the pattern of migration and may not occur during the period of active in-season Panel Area management. PSC staff have developed models to predict the in-river migration timing and associated en route mortality rate of Late-run sockeye and will advise the Panel if changes to pre-season assumptions are warranted. Staff will not be able to provide stock-specific assessments for Cultus sockeye due to their low forecast abundance relative to much more abundant co-migrating stocks. Consequently, assessments of Cultus sockeye harvest impacts will rely on the use of other, more abundant Late-run stocks as indicators of their relative contribution to catches.
3. A combination of pre-season planning and in-season assessments of Late-run abundance and migration timing could potentially provide for a flexible approach to management. Canada has provided an escapement plan for all stock aggregates including Late-run sockeye that varies total allowable mortality rates with levels of abundance. Escapement targets will also be modified based on Management Adjustments derived from Fraser River environmental conditions for Early Stuart, Early Summer-run and Summer-run stocks, and based on in-season estimates of upstream timing for Late-run stocks. For Late-run stocks, if in-season updates of abundance are significantly larger than the 50p level forecast and upstream migration is significantly later than expected (e.g., 1,000,000 fish and mid – September), the allowable exploitation rate may increase above 20%. However, this possibility is unlikely, given the forecasted range of abundances and the upstream migration dates that have occurred on this cycle since 1996.
4. The pre-season fishing plan assumes an 8 day separation in the 50% marine migration timing date (through Juan de Fuca Strait; Area 20) between Summer-run (July 30) and Late-run sockeye (August 7).

ADDITIONAL ELEMENT

- The management strategy for Late-run sockeye is to limit the exploitation rate to 20% at run sizes lower than 500,000 fish, and to increase the total allowable mortality rate up to a maximum of 60% at a run size of 1,000,000 fish. Canada will be managing Cultus sockeye to a fixed exploitation rate of 20%.
- To help ensure that Late-run conservation objectives are achieved, in-season decisions regarding fisheries directed at Summer-run sockeye will be constrained by potential harvest impacts on Late-run sockeye. Late-run sockeye catches will be estimated primarily with DNA stock identification methods.

[10] Late-run here refers to the Late-run timing group, excluding Birkenhead and a few minor miscellaneous sockeye stocks.

APPENDIX F: 2008 REGULATIONS

The Fraser River Panel approved regulations for the management of the Fraser River sockeye and pink salmon fishery in Panel Area waters and submitted these to the Pacific Salmon Commission. The Commission approved the Fishery Regime and Regulations and submitted these to the respective national governments for approval on June 12, 2008.

Canadian Fraser River Panel Area

In accordance with Article VI, Paragraph 5 of the Pacific Salmon Treaty, the Commission recommends to the Canadian Government the adoption of the following Fishing Regime developed by the Fraser River Panel, namely:

1. a) No person shall commercially fish for sockeye or pink salmon in Pacific Fishery Management Area 20-1, 3 and 4 with nets from the 29th day of June, 2008, to the 6th day of September, 2008, both dates inclusive.

   b) No person shall troll commercially for sockeye or pink salmon in Pacific Fishery Management Area 20-1, 3 and 4 from the 29th day of June, 2008, to the 6th day of September, 2008, both dates inclusive.

2. a) No person shall commercially fish for sockeye or pink salmon in Pacific Fishery Management Areas 17 and 18 with nets from the 29th day of June, 2008, to the 4th day of October, 2008, both dates inclusive.

   b) No person shall troll commercially for sockeye or pink salmon in Pacific Fishery Management Area 18-1, 4 and 11 from the 29th day of June, 2008, to the 4th day of October, 2008, both dates inclusive.

3. a) No person shall commercially fish for sockeye or pink salmon with nets in Pacific Fishery Management Area 29 from the 29th day of June, 2008, to the 11th day of October, 2008, both dates inclusive.

   b) No person shall troll commercially for sockeye or pink salmon in Pacific Fishery Management Area 29 from the 29th day of June, 2008, to the 11th day of October, 2008, both dates inclusive.

4. The following Fraser River Panel Area waters are excluded:

   a) High Seas westerly of the Bonilla Point-Tatoosh Island Lighthouse Line.

   b) Pacific Fishery Management Area 19, Area 20-2 and 5 to 7 and Area 29-8.

   c) Commercial troll fishing in Pacific Fishery Management Area 17, Area 18-2, 3 and 5 to 10.

During the 2008 season, the Fraser River Panel will adopt Orders establishing open fishing periods based on a 2008 Management Plan adopted by the Panel. This Plan will be designed to achieve Pacific Salmon Treaty-mandated conservation objectives, international allocations of the catch, and domestic goals of the Parties.

United States Fraser River Panel Area

In accordance with Article VI, Paragraph 5 of the Pacific Salmon Treaty, the Commission recommends to the United States Government the adoption of the following Fishing Regime developed by the Fraser River Panel, namely:

Treaty Indian Fisheries:

1. No Treaty Indian shall commercially fish for sockeye or pink salmon in Puget Sound Salmon Management and Catch Reporting Areas 4B, 5 and 6C with drift gillnets or purse seines from the 29th day of June, 2008 to the 6th day of September, 2008, both dates inclusive.
2. No Treaty Indian shall commercially fish for sockeye or pink salmon in Puget Sound Salmon Management and Catch Reporting Areas 6, 6A, 7 and 7A with nets from the 29th day of June, 2008, to the 13th day of September, 2008, both dates inclusive.
3. No Treaty Indian shall commercially fish for sockeye or pink salmon with nets in that portion of Puget Sound Salmon Management and Catch Reporting Area 7A lying westerly of a straight line drawn from the low water range marker in Boundary Bay on the International Boundary through the east tip of Point Roberts in the State of Washington to the East Point Light on Saturna Island in the Province of British Columbia from the 14th day of September, 2008, to the 4th day of October, 2008, both dates inclusive.

All Citizen Fisheries:

1. No person shall fish for sockeye or pink salmon in Puget Sound Salmon Management and Catch Reporting Areas 4B, 5, and 6C with nets from the 29th day of June, 2008, to the 6th day of September, 2008, both dates inclusive.
2. No person shall fish for sockeye or pink salmon in Puget Sound Salmon Management and Catch Reporting Areas 6, 6A, 7 and 7A with nets from the 29th day of June, 2008, to the 13th day of September, 2008, both dates inclusive.
3. No person shall fish for sockeye or pink salmon with nets in that portion of Puget Sound Salmon Management and Catch Reporting Area 7A lying westerly of a straight line drawn from the low water range marker in Boundary Bay on the International Boundary through the east tip of Point Roberts in the State of Washington to the East Point Light on Saturna Island in the Province of British Columbia from the 14th day of September, 2008, to the 4th day of October, 2008, both dates inclusive.

The following Fraser River Panel Area waters and fisheries are excluded:

Treaty Indian and All Citizen Fisheries:

1. High Seas westerly of the Bonilla Point-Tatoosh Island Lighthouse Line.
2. Puget Sound Salmon Management and Catch Reporting Areas 6B, 6D, 7B, 7C, 7D and 7E.

During the 2008 season, the Fraser River Panel will adopt Orders establishing open fishing periods based on a 2008 Management Plan adopted by the Panel. This Plan will be designed to achieve Pacific Salmon Treaty-mandated conservation objectives, international allocations of the catch, and domestic goals of the Parties.

APPENDIX G: 2008 FRASER RIVER PANEL IN-SEASON ORDERS

To provide for adequate escapement of the various stocks of Fraser River sockeye and pink salmon and for the prescribed allocation of catch: (a) internationally, between the U.S. and Canada and (b) domestically, among the commercial user groups in Canada and the U.S., the Fraser River Panel formulated the following orders to regulate Panel Area fisheries in 2008.

July 18, 2008
- United States
  - Treaty Indian Fishery
    - Areas 4B, 5 and 6C
      - Open to drift gillnets from 12:00 p.m. (noon), Saturday, July 19, 2008 to 12:00 p.m. (noon) Wednesday, July 23, 2008.

July 22, 2008
- United States
  - Treaty Indian Fishery
    - Areas 4B, 5 and 6C
      - Extended for drift gillnets from 12:00 p.m. (noon), Wednesday, July 23, 2008 to 12:00 p.m. (noon) Saturday, July 26, 2008.

July 24, 2008
- Canada
  - Area 20-1, 3, 4
    - Open to Area B purse seine, ITQ Demonstration Fishery, 6:00 a.m. Sunday, July 27, 2008 until further notice on a daily basis between the hours of 6:00 a.m. To 9:00 p.m. An update on the status of this fishery including the duration will be made on Monday, July 28 at the next Fraser River Panel meeting (please refer to DFO Fishery Notice FN0510 for further details).
  - Area 18-1, 18-4 and 18-11 and Area 29-1 to 6
    - Open to Area H troll, ITQ Demonstration Fishery 12:01 a.m., Saturday, July 26 until further notice (please refer to DFO Fishery Notice FN0508 for further details).
- United States
  - Treaty Indian Fishery
    - Areas 4B, 5 and 6C
      - Extended for drift gillnets from 12:00 p.m. (noon), Saturday, July 26, 2008 to 12:00 p.m. (noon) Tuesday, July 29, 2008.
    - Areas 6, 7, and 7A
      - Open to net fishing from 6:00 a.m., Sunday, July 27, 2008 to 10:00 a.m., Monday, July 28, 2008.
  - All Citizen Fishery:
    - Areas 7 and 7A
      - Open to purse seines from 7:00 a.m. To 7:00 p.m. Friday, July 25, 2008.
    - Areas 7 and 7A
      - Open to gillnets from 8:00 a.m. To 8:00 p.m., Friday, July 25, 2008
    - Areas 7 and 7A
      - Open to reefnets from 6:00 a.m. To 6:00 p.m., Monday, July 28, 2008.

July 28, 2008

Canada

Area 20-1, 3, 4

Closes for Area B purse seine, ITQ Demonstration Fishery, at 6:00 p.m., Monday, July 28 (please refer to DFO Fishery Notice FN0525 for further details).

Area 18-1, 18-4 and 18-11 and Area 29-1 to 6

Closes for Area H troll, ITQ Demonstration Fishery 6:00 p.m., Monday, July 28 (please refer to DFO Fishery Notice FN0526 for further details).

United States

Treaty Indian Fishery

Areas 4B, 5 and 6C

Extended for drift gillnets from 12:00 p.m. (noon), Tuesday, July 29, 2008 to 12:00 p.m. (noon) Wednesday, July 30, 2008.

Areas 6, 7, and 7A

Open for net fishing from 12:45 p.m., Monday, July 28, 2008 to 3:00 p.m., Tuesday, July 29, 2008.

All Citizen Fishery

Areas 7 and 7A

Open to purse seines from 5:00 a.m. To 9:00 p.m. Tuesday, July 29, 2008.

Areas 7 and 7A

Open to gillnets from 8:00 a.m. To 11:59 p.m. (midnight), Tuesday, July 29, 2008

Areas 7 and 7A

Open to reefnets from 5:00 a.m. To 9:00 p.m., Tuesday, July 29, 2008.

July 29, 2008

United States

Treaty Indian Fishery

Areas 4B, 5 and 6C

Extended for drift gillnets from 12:00 p.m. (noon), Wednesday, July 30, 2008 to 12:00 p.m. (noon) Saturday, August 2, 2008.

Areas 6, 7, and 7A

Extended for net fishing from 3:00 p.m., Tuesday, July 29, 2008 to 11:59 p.m. (midnight), Thursday, July 31, 2008.

All Citizen Fishery

Areas 7 and 7A

Open to purse seines from 5:00 a.m. To 9:00 p.m. Wednesday, July 30, 2008 and from 5:00 a.m. To 9:00 p.m. Thursday, July 31, 2008.

Areas 7 and 7A

Open to gillnets from 8:00 a.m. To 11:59 p.m. (midnight), Wednesday, July 30, 2008 and from 8:00 a.m. To 11:59 p.m. (midnight), Thursday, July 31, 2008.

Areas 7 and 7A

Open to reefnets from 5:00 a.m. To 9:00 p.m. Wednesday, July 30, 2008 and from 5:00 a.m. To 9:00 p.m. Thursday, July 31, 2008.

August 1, 2008

United States

Treaty Indian Fishery

Areas 4B, 5 and 6C

The previously announced drift gillnet fishery that was scheduled to close at 12:00 p.m. (noon) Saturday, August 2, 2008 will now close at 6:00 p.m., Friday, August 1, 2008.

Fraser River Panel control of Panel Areas was relinquished in accordance with the pre-season Regulations (Appendix F) as follows: (1) Canada: Area 20 on September 6; Areas 17 and 18 on October 4; and Area 29 on October 11; (2) United States: Areas 4B, 5 and 6C on September 6; Areas 6, 6A, 7 and 7A on September 13, and the remaining portions of Area 7A on October 4.

APPENDIX H: PSC STOCK MONITORING, IDENTIFICATION AND ASSESSMENT PROGRAMS

Stock Monitoring

Stock monitoring programs monitor and assess the abundance and migration timing of Fraser River sockeye and pink salmon at different points along their migration route. In conjunction with stock composition information from the Stock Identification Group, the Stock Monitoring Group uses test fishery data from marine and freshwater areas, hydro-acoustic abundance estimates collected in the Fraser River at Mission, B.C., and visual observations at Hells Gate. In addition to providing estimates of daily and cumulative passage in marine areas and at Mission, stock monitoring analyses provide projections of the number of fish migrating between marine areas and Mission, and estimates of diversion through Johnstone Strait. This information is required for the development of fishing plans that aid in meeting spawning escapement and catch allocation objectives.

The migrations of Fraser sockeye and pink salmon through marine areas are tracked primarily through commercial, test and First Nations fisheries in marine areas, beginning in Juan de Fuca and Johnstone Straits and extending to the mouth of the Fraser River. Information about upstream migration in the Fraser River is obtained from the hydroacoustic program at Mission, lower river gillnet test fisheries, visual observations at Hells Gate and analysis of catches in Fraser River First Nations fisheries. Between July 9 and August 24, estimates of Mission sockeye escapements by stock group were derived by applying species composition data to the hydroacoustic estimates. Prior to July 9 and after August 24, upstream passage was monitored solely using Whonnock (Area 29-16) test fishery data. Daily observations at Hells Gate between July 2 and August 29 provided qualitative information on the success of upstream fish passage and abundance.

A. Test Fishing

Commercial fisheries historically provided much of the data used to assess abundance and migration timing. Limited commercial fishing in recent years, however, has reduced the availability of this information. PSC staff therefore rely heavily on test fisheries to obtain abundance-related data such as catch and catch-per-unit-effort (CPUE), and biological samples from which stock composition estimates are derived. While Table 4 in the main body of the report describes when test fisheries were conducted, Table 1 below summarizes more detailed information about the type of nets and sampling strategy used.

Information about the migration of Fraser sockeye and pink salmon through marine areas is provided primarily by test fisheries in Area 20 (Juan de Fuca Strait) and Areas 12 and 13 (Johnstone Strait), but is augmented during the early part of the season by test fisheries in U.S. Areas 5 (Juan de Fuca Strait) and 7 (San Juan Islands). Test fisheries in the Fraser River (Cottonwood, Whonnock) are used to assess species and stock composition to distribute Mission passage estimates across various stock groups, but also provide abundance estimates through the use of CPUE models when the Mission hydroacoustic program is not active or when the presence of pink salmon confounds the estimation of hydroacoustic-based sockeye passage at Mission.

In 2008, catches in the Area 20 gillnet test fishery began to build in July, with a pronounced peak on July 19-21. Catches in this test fishery remained intermittently strong through to August 5. These catches were the first signal of the very early sockeye migration timing observed in 2008. Catches in the Area 20 purse seine test fishery were low in 2008, with a peak of only 224 sockeye/set on July 22. Weak catches in the Round Island (Area 12) gillnet fishery were indicative of the low diversion through that route, although small peaks were identified on July 21 and August 3. Catches in the Area 12 purse seine test fishery remained relatively low compared to past years, although considerably higher than in the Area 13 purse seine test fishery which on many days were less than 10 sockeye/set.

Table 1. Sampling details about test fisheries conducted in 2008.

Area	Location	Gear	Number of Vessels	Net Length (m)	Net Depth (meshes)	Mesh Size (mm)	Mesh Size (in)	Number of Sets	Set Duration (minutes)
Canadian Panel Areas									
20	Juan de Fuca Str.	Gillnet	2	547	90	130	5 1/8	2	300
20	Juan de Fuca Str.	Purse Seine	1	547	875	95	3 3/4	6	20
29-14	Cottonwood	Gillnet	1	292	Variable	Variable		2	30
29-16	Whonnock	Gillnet	1	319	Variable	Variable		2	20
United States Panel Areas									
5	Juan de Fuca Str.	Gillnet	1	803	220	130	5 1/8	2	400
7	San Juan Islands	Reefnet [1]	3	n/a	n/a	n/a	n/a	n/a	n/a
Canadian Non-Panel Areas									
12	Queen Charlotte Str. (Round I.)	Gillnet [2]	1	365	60	130	5 1/8	4	100
12	Johnstone Str. (Naka Cr.)	Gillnet [2]	1	365	90	130	5 1/8	4	100
12	Johnstone Str. (Blinkhorn)	Purse Seine	1-2	401	575	95	3 3/4	6	20
13	Lower Johnstone Str.	Purse Seine	1-2	401	575	95	3 3/4	6	20

1 Reefnet observations are made during periods of favorable tides. Fish are counted as they swim through the gear, but are not harvested.

2 Round Island vessels used 60 mesh nylon gillnets and Naka Creek vessels used 90 mesh Alaska twist gillnets.

In the Fraser River, sockeye catches at both Cottonwood (Area 29-13) and Whonnock (Area 29-16) were relatively low (<100 fish on most days) compared to past years' catches on this cycle. Peak catches at these sites did not line up well with each other or with peak escapements at Mission. Test fishing catches at Cottonwood peaked on August 3-4, and at Whonnock peaked on July 17 and again on July 30-31, while sockeye abundance at Mission peaked on July 25. Possible reasons for these timing differences are differential seal predation at the two test fishing sites and the lack of strong timing signals due to lower than normal daily abundances in the river.

i. Seal Deterrent Study

With funding provided by the Southern Restoration and Endowment Fund (SEF), Staff intended to continue with the development and testing of an electric deterrent system[11] designed to reduce the rate that seals remove salmon from the Cottonwood test fishery gillnet. A 220 m long multi-panel gillnet was integrated with 12 independent electric arrays. Each array was connected to a separate rechargeable battery powered pulse generator unit developed and built by Smith-Root Inc. The study encountered several technical problems with the pulse units, however, which resulted in postponement of the field tests until the 2009 fishing season.

B. Mission Hydroacoustic Program

PSC Staff have operated a hydroacoustic facility on the Fraser River near the Mission Railway Bridge since 1977, for the purpose of providing timely in-season estimates of sockeye and pink salmon escapement through the lower river. This program has benefited from improved technologies and research in recent years [12, 13]. In 2008, daily abundance at Mission was estimated

[11] Forrest, K.W., Cave, J.D., Michielsens, C.G.J., Haulena, M. and Smith, D.V. 2009. Evaluation of an electric gradient to deter seal predation on salmon caught in gill-net test fisheries. North American Journal of Fisheries Management 29: 855-894.

[12] Xie, Y., A. P. Gray, F. J. Martens, and J. D. Cave. 2008. Development of a shore-based hydroacoustics system on the right bank of the Lower Fraser River to monitor salmon passages: A project report to Southern boundary restoration and enhancement fund. Pacific Salmon Commission, Vancouver, British Columbia. April, 2008.

using a split-beam hydroacoustic system on the south shore (i.e., "left bank") of the Fraser River, combined with a downward looking split-beam system mounted on a vessel that transected the river. These systems operated 24-hrs a day and provided information about target density, fish behaviour, transecting speed and trajectories of the vessel, and depth and orientation of the transducer. Additional work was focused on gathering independent diagnostic information (e.g., using a DIDSON imaging sonar) to verify assumptions used in the estimation procedure.

Daily estimates of fish abundance past Mission were produced by combining estimates from the shore-based and vessel-based split-beam systems. The shore-based system consisted of two side-looking elliptical beam transducers (2°×10° and 4°×10°) attached to a rotator to control pan and tilt, and an attitude sensor to verify the transducer's aim. An extensible fish-deflection weir prevented fish from swimming in acoustic blind zones (behind or too close to the transducers), and also increased the duration for which they were insonified. Transducer aims were optimized to reduce the unsampled areas where migratory abundance must be estimated by extrapolation.

The vessel-based system transected the river every five minutes to obtain target density information using a downward looking circular beam transducer (15°). To collect information on the direction and speed of travel of fish, this system was also employed daily for three sampling periods each at stations in the south, north and centre of the channel. GPS (Global Positioning System) information was incorporated into these data.

Traces of individual targets as they passed through the sound-beam were acquired by analyzing the echo data from both shore and vessel-based systems using an alpha-beta tracker [14, 15]. The resulting trace data (i.e., "tracks") were then classified as fish or noise (e.g., debris, entrained air bubbles) using a statistical method called Discriminant Function Analysis [16] (DFA). The integrity of the tracks was verified by trained staff, and unusual or atypical targets were identified and removed using graphical user interface (GUI) software. This was performed each day for all 24-hours and separately for both shore and vessel-based data. The final fish track data were analyzed to produce daily statistical summaries of detected fish samples. Using a flux estimation program, daily estimates of fish abundance were derived from the processed shore and vessel-based data in both the sampled and unsampled areas. The resulting estimates of daily fish passage were then analyzed to obtain Mission passage by species, with the sockeye component further apportioned into stock groups.

During the month of August, as the abundance of fish in the river began to increase, a standard dual-frequency identification sonar (DIDSON) was deployed from the left-bank weir. The DIDSON was attached to the same support structure as the standard split-beam transducers, and so was located the same distance from shore and 40 cm upstream. This allowed for coverage of the split-beam blind-zone and target verification of near-shore targets. The DIDSON was operated predominately in high frequency mode at 1.8Mhz and was set to cover a 10-m range window starting at 10 m from the sonar head. This information was used in-season to verify the estimates of fish passage and behaviour by the split-beam system in the same sampling area. The system was also used for species validation, as there were reports of numerous jack chinook being caught by a fish wheel operated by LGL in the lower river. During the standard post-season review process the DIDSON data sets were analyzed, and target counts and length information were gathered from time periods identified as periods of high jack chinook passage by the LGL fish wheel. We found that 20-25% of measured target lengths were consistent with the reported lengths of chinook jacks. This range of percentages was substantially lower than observed at the fish wheel, but similar to the percentage derived in-season from Whonnock test fishery data.

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[13] Xie, Y., C. G. J. Michielsens, A. P. Gray, F. J. Martens, and J. L. Boffey. 2008. Observations of avoidance reactions of migrating salmon to a mobile survey vessel in a riverine environment. Can. J. Fish. Aquat. Sci. 65: 2178-2190.

[14] Blackman, S. S. and R. Popoli. Design and Analysis of Modern Tracking Systems. Artech House, Boston, 1999.

[15] Xie, Y., A. P. Gray, F. J. Martens, J. L. Boffey and J. D. Cave. 2005. Use of dual-frequency identification sonar to verify salmon flux and to examine fish behaviour in the Fraser River. Pacific Salmon Comm. Tech. Rep. No. 16: 58 p. Vancouver, B.C.

[16] McLachlan, G. J. Discriminant Analysis and Statistical Pattern Recognition. Wiley, New York, 1992.

Also in 2008, a long range dual-frequency identification sonar (DIDSON-LR) and a side-looking split-beam system were operated independently on the right-bank of the river (north shore) for the entire migration period. The data was analyzed in-season to monitor changes in behaviour or anomalous migration behaviour. We found the DIDSON-LR was not as reliable for length measurements as the standard DIDSON.

Data were also collected using the traditional single-beam hydroacoustic system on the vessel that transected the river. Estimates using various combinations of single and split-beam data collected from the vessel were compared in post-season investigations. None of these comparisons indicated major bias issues in the 2008 abundance estimates.

i. Additional Hydroacoustic Studies

The methods employed to estimate fish abundance in offshore areas use fish speed and direction of travel statistics that are obtained from shore-based sampling programs. This method could result in biased estimates if fish behaviour differs in offshore areas versus near-shore areas. Furthermore, past studies have demonstrated that fish react to nearby vessels[13,15] and therefore may not be acoustically detected by the transecting vessel. Alternative methods of sampling offshore areas were therefore explored in 2008. An offshore survey method was tested that used side-scan acoustic systems on-board a stationary vessel. Three locations across the river were systematically sampled over a 10-day period, and the resulting estimates were expanded to the entire offshore area by a Bayesian (correlation-based) spatial statistical model. While further testing is required, the technique appeared to provide a more robust sampling method for offshore areas because it increased sample sizes, reduced vessel-avoidance behaviour and provided more accurate measurements of fish behaviour than could be obtained from the traditional method.

Stock Identification

PSC staff conduct programs designed to identify the stock proportions of Fraser River sockeye salmon in commercial, test and First Nations catches. These data provide information on the abundance and timing of sockeye as they migrate to their natal rivers in the Fraser River watershed. Stock identification data are also used to account for Fraser River sockeye wherever they may be caught, and to apportion the daily estimates of sockeye escapement past Mission into discrete stock groups.

Stock identification methods for sockeye salmon in 2008 used DNA[17] and scale pattern analyses[18] for fish caught in marine and in-river fisheries. Such methods involve comparing the attributes of individuals in mixture samples (e.g., from mixed-stock fisheries) to the attributes of pure samples obtained from the spawning grounds of each of the named stocks (i.e., "standards" or "baselines"). The main attributes used to identify Fraser sockeye stocks are allelic frequencies estimated via DNA analyses and scale patterns that reflect lacustrine (freshwater) growing conditions during their first year of life.

Analyses of samples from commercial and test fishery catches were conducted daily, beginning in late June and continuing through early September. Commission staff sampled test fishery catches and commercial sockeye landings at several sites in British Columbia and Washington (Greater Vancouver, Port Renfrew, Nanaimo, Port Hardy and Campbell River in British Columbia; and Bellingham and Sekiu in Washington). The Alaska Department of Fish and Game collected samples for the PSC from the District 104 purse seine fishery, while DFO provided samples from Johnstone Strait test fisheries. At the PSC's request, DFO and First Nations personnel coordinated sampling of some First Nations fisheries in marine and in-river areas. Of these, a significant contribution to the total was provided via test fishing for hydroacoustic research undertaken in the lower Fraser Canyon at Qualark Creek.

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[17] Beacham, T.D., M. Lapointe, J.R. Candy, B. McIntosh, C. MacConnachie, A. Tabata, K. Kaukinen, L. Deng, K.M. Miller and R.E. Withler. 2004. Stock identification of Fraser River sockeye salmon using microsatellites and major histocompatibility complex variation. Trans. Am. Fish. Soc. 133: 1117-1137.

[18] Gable, J. and S. Cox-Rogers. 1993. Stock identification of Fraser River sockeye salmon: methodology and management application. PSC Tech. Rep. No. 5: 36p.

Stock identification results are prone to overestimation of stocks that are either absent or present in very low relative proportions. One technique that is frequently used to minimize small-stock bias is to use independent information on migration timing and spatial distribution to exclude unlikely stocks from consideration in analytical models. In 2008, the Stock Identification group explored an alternative method of adjusting results to minimize this source of bias. Results from previous years have returned higher than expected proportions of non-Fraser populations in marine catches. To determine whether these proportions may have resulted from misidentification, baseline data from Fraser and non-Fraser populations were included in the analyses of samples taken from the Fraser River. This approach identified only a small amount of classification error (implying little over-estimation of non-Fraser stocks in marine samples), and permitted better comparisons between marine and in-river samples. To adjust for the error that the broader baseline introduced, apparently incorrect non-Fraser allocations in samples from the river were removed and estimates for Fraser stocks were increased proportionally.

Proportions of Fraser River sockeye in District 104 fisheries were estimated using discriminant function analysis of scale data for age 4_2 sockeye. Unlike 2007, catches were small and there was little indication of Fraser sockeye presence to warrant intensive DNA sampling. The proportions of age 4_2 Fraser sockeye were expanded to account for other ages, on the basis of estimated age compositions of Fraser sockeye sampled in Area 12 and Area 20 test fisheries. District 104 purse seine catches of sockeye in 2008 totalled 42,000 sockeye. The estimated catch of Fraser sockeye was 2,000 fish of all ages. The apparently southern marine distribution of Fraser River sockeye in 2008 is consistent with this relatively small catch estimate of Fraser sockeye in southeast Alaska.

Stock Assessment

Assessment of Fraser River sockeye abundance by stock group is primarily based on catch, effort, escapement and stock composition data. Commercial fishing was very restricted in 2008, so test fishing catch and CPUE data were used extensively for assessing abundance by stock group. These data are analysed using cumulative-normal, cumulative-passage-to-date and Bayesian models[19, 20]. The cumulative-normal model compares the reconstructed daily migration pattern to ideal run-timing curves, assuming the run is normally distributed. The cumulative-passage model compares the total run observed up to a particular date in the past to the total abundance for those years. Based on the resulting regression equation and the in-season estimate of the run-to-date, a total abundance estimate for the current year is obtained. The Bayesian model incorporates both models by using a similar technique as the cumulative-normal model to compare the observed run to a hypothetical normally distributed run, and by using historical data to help inform the abundance estimates in the current year. Theoretically the Bayesian model should provide more stable estimates since it relies on both in-season data as well as historical data.

[19] Pacific Salmon Commission. 1995. Pacific Salmon Commission run-size estimation procedures: An analysis of the 1994 shortfall in escapement of Late-run Fraser River sockeye salmon. Pacific Salmon Comm. Tech. Rep. No. 6: 179 p.

[20] Pacific Salmon Commission. 1998. Report of the Fraser River Panel to the Pacific Salmon Commission on the 1995 Fraser River sockeye and pink salmon fishing season. Vancouver, B.C., 64 p.

APPENDIX I: HISTORICAL CATCH, ESCAPEMENT AND PRODUCTION DATA, AND DETAILED 2008 TAC CALCULATION

Table 1. Catch, spawning escapement, RSA and run size of Fraser River sockeye salmon for cycle years 1996-2008.

	Fraser Sockeye Salmon			
	1996	**2000**	**2004**	**2008**
CANADIAN CATCH	**1,800,700**	**1,860,000**	**2,006,700**	**481,100**
Commercial Catch	**955,000**	**955,200**	**1,057,600**	**16,200**
Panel Area	782,000	422,400	256,800	11,600
Non-Panel Areas	173,000	532,800	800,800	4,600
First Nations Catch	**754,000**	**870,300**	**890,500**	**447,300**
Marine FSC	76,000	90,900	256,200	31,900
Fraser River FSC	678,000	779,400	634,300	415,400
Economic Opportunity	0	0	0	0
Non-commercial Catch	**91,700**	**34,500**	**58,600**	**17,600**
Marine Recreational	5,600	6,100	4,800	100
Fraser Recreational	8,100	20,200	50,300	16,400
Charter	0	7,800	0	1,200
ESSR *	78,000	400	3,500	0
UNITED STATES CATCH	**306,000**	**496,100**	**258,800**	**51,000**
Washington Total	**270,000**	**493,600**	**195,600**	**49,400**
Commercial catch	**257,000**	**490,200**	**195,500**	**48,000**
Treaty Indian	224,000	260,100	114,400	39,000
All Citizen	33,000	230,100	81,100	9,000
Non-commercial Catch	**13,000**	**3,400**	**100**	**1,400**
Ceremonial	0	3,400	100	1,400
Recreational	0	0	0	0
Gear Modification Study	13,000	0	0	0
Alaska	**36,000**	**2,500**	**63,300**	**1,600**
TEST FISHING CATCH	**79,000**	**94,600**	**73,400**	**41,300**
PSC (Panel Areas)	**71,000**	**72,400**	**24,100**	**36,200**
Canada	67,000	72,400	24,100	26,900
United States	4,000	0	0	9,300
Canada (non-Panel Areas)	**8,000**	**22,200**	**49,400**	**5,100**
TOTAL RUN	**4,518,100**	**5,201,500**	**4,184,800**	**1,741,000**
Total Catch in All Fisheries	**2,185,700**	**2,450,700**	**2,339,000**	**573,400**
Adult Spawning Escapement	**2,061,600**	**2,352,900**	**524,400**	**815,500**
Jack Spawning Escapement	**29,700**	**1,200**	**900**	**1,500**
Run-size Adjustment	**241,000**	**396,600**	**1,320,600**	**350,500**

* Terminal harvest of Weaver Creek sockeye that are "Excess Salmon to Spawning Requirements"

Table 2. Catch of Fraser River sockeye salmon in Canadian First Nations fisheries by area for cycle years 1996-2008.*

Fishing Area	FN Catch by Cycle Year			
	1996	2000	2004	2008
Fraser River	**677,600**	**785,800**	**634,300**	**415,400**
Fraser River Mainstem	**616,800**	**733,400**	**617,900**	**391,600**
Below Port Mann	93,700	100,400	109,300	54,800
Port Mann to Mission	71,100	61,000	89,800	35,800
Mission to Hope	77,200	135,300	81,100	76,000
Hope to Sawmill Cr.	219,400	165,300	203,700	102,000
Sawmill Cr. to Kelly Cr.	144,200	252,700	118,300	111,200
Kelly Creek to Prince George	7,000	13,700	11,500	5,600
Above Prince George	4,200	5,000	4,200	6,100
Tributaries	**60,800**	**52,400**	**16,400**	**23,800**
Harrison/Lillooet System	n/a	n/a	n/a	n/a
Thompson System	400	1,100	3,400	2,400
Chilcotin System	52,100	38,000	9,200	10,400
Nechako System	6,000	6,000	0	6,400
Stuart System	2,300	7,300	3,800	4,700
Marine Areas	**76,000**	**90,900**	**256,200**	**31,900**

* Data supplied by DFO.

Table 3. Escapement of sockeye salmon to Fraser River spawning areas for cycle years 1996-2008. *

DISTRICT Stock Group Stream/Lake	Fraser Sockeye 1996	2000	2004	2008	
NORTHEAST					
Upper Bowron R.	8,176	13,440	916	1,005	
STUART					
Early Stuart					
Takla L. Streams	33,318	34,125	3,418	6,100	
Middle R. Streams	27,085	30,049	3,812	17,298	
Trembleur L. Streams	27,168	25,684	2,041	6,378	
Late Stuart					
Middle R.	9,290	51,426	12,938	5,616	
Tachie R.	48,795	368,834	60,838	122,929	
Miscellaneous	4,909	34,137	9,642	18,024	
NECHAKO					
Nadina R. (Late)	8,908	164,529	14,276	32,724	
Nadina Channel	29,746	34,852	8,327	33,251	
Stellako R.	332,207	371,604	86,738	159,737	
QUESNEL					
Horsefly R.	23,128	34,545	4,379	5,324	
Horsefly Channel	11,104	1,125	0	0	
McKinley Cr.	9	457	124	77	
Mitchell R.	6,946	27,069	5,452	1,564	
Miscellaneous	0	507	267	126	
CHILCOTIN					
Chilko R. & L.	974,846	758,941	91,909	249,863	
Taseko L.	1,470	3,000	320	60	
SETON-ANDERSON					
Gates Cr.	69,270	56,226	757	5,420	
Gates Channel	30,728	32,421	8,849	9,418	
Portage Cr.	3,422	1,269	1,287	97	
NORTH THOMPSON					
North Thompson R.	1,945	11,072	2,009	3,879	
Raft R.	46,592	66,292	5,611	10,406	
Fennell Cr.	32,279	10,155	2,718	2,270	
SOUTH THOMPSON					
Early Summer-run					
Scotch Cr.	4,609	3,765	783	654	
Seymour R.	21,654	25,465	1,323	1,350	
Anstey R.	763	2,747	65	119	
Eagle R.	4,700	13,068	155	1,345	
Miscellaneous	34,538	81,339	1,562	1,520	
Late-run					
Adams R.	11,544	781	2,847	151	
Lower Shuswap R.	635	50	144	11	
Middle Shuswap R.	58	0	0	0	
Miscellaneous	229	24	3	2	
HARRISON-LILLOOET					
Birkenhead R.	56,112	13,842	37,617	19,500	
Big Silver Cr.	3,518	8,956	19,831	2,419	
Harrison R.	15,379	4,343	2,106	6,717	
Weaver Cr.	38,059	1,237	912	1,309	
Weaver Channel	34,011	5,376	24,467	1,447	
LOWER FRASER					
Nahatlatch R. & L.	13,537	5,165	1,097	573	
Cultus L.	2,022	1,227	52	340	*1*
Upper Pitt R.	50,081	42,638	60,942	16,921	
Chilliwack L./Dolly Varden Cr.	4,228	8,160	40,329	67,822	
MISCELLANEOUS *2*	526	3,035	3,595	1,647	
ADULTS	2,027,544	2,352,977	524,458	815,413	
JACKS	28,651	1,179	851	1,548	
TOTAL NET ESCAPEMENT	2,056,195	2,354,156	525,309	816,961	

* Estimates are from DFO.

1 Does not include sockeye removed for broodstock.

2 'Miscellaneous' category includes fish from small stocks throughout the Fraser watershed.

Table 4. Detailed calculation of total allowable catch and the achievement of international catch allocations for Fraser River sockeye salmon by management group in 2008. These calculations use the in-season estimates of run size, spawning escapement target, management adjustment and test fishing catch at the time the Panel relinquished control of the last U.S. Panel Area (October 4), in accordance with Annex IV of the Treaty and the February 15, 2008 Commission Guidance.

TAC Calculations	Fraser Sockeye						
	Early Stuart	Early Summer	Summer	Birken -head	Late	Total	
RUN STATUS, ESCAPEMENT NEEDS & AVAILABLE SURPLUS							
In-season Abundance Estimate	40,000	450,000	980,000	55,000	190,000	1,715,000	
Adjusted Spawning Escapement Target *	40,000	187,600	520,000	29,200	152,000	928,800	
Spawning Escapement Target (SET)	40,000	180,000	520,000	29,200	152,000	921,200	
%SET from TAM rules	*100%*	*40%*	*53%*	*53%*	*80%*		
Management Adjustment (MA)	27,200	7,600	0	0	n/a	34,800	
Proportional MA (pMA)	*0.68*	*0.0420*	*0*	*0*	*12.31*		
Test Fishing (TF)	400	11,600	23,800	1,500	4,000	41,300	
Surplus above Adjusted SET & TF	0	250,800	436,200	24,300	34,000	745,300	
DEDUCTIONS & TAC FOR INTERNATIONAL SHARING							
Aboriginal Fishery Exemption (AFE)	0	100,400	276,700	5,600	17,300	400,000	
Total Deductions (Adj.SET + TF + AFE)	40,400	299,600	820,500	36,300	173,300	1,370,100	
Available TAC (Abundance - Deductions)	0	150,400	159,500	18,700	16,700	345,300	
UNITED STATES (Washington) TAC							
Propor. distrib. TAC - Payback	0	23,300	24,700	2,900	2,600	53,600	
Proportionally distributed TAC **	0	24,800	26,300	3,100	2,800	57,000	16.5%
Payback	0	-1,500	-1,600	-200	-200	-3,400	
Washington Catch	0	9,900	34,800	1,200	3,600	49,400	
Deviation from TAC - Payback	0	13,400	-10,000	1,700	-1,000	4,200	
CANADIAN TAC							
Propor. distrib. TAC + Payback + AFE	0	227,500	411,500	21,400	31,400	691,800	
Propor. distrib. TAC + U.S. Payback	0	127,100	134,800	15,800	14,100	291,800	84.5%
AFE	0	100,400	276,700	5,600	17,300	400,000	
Canadian Catch excluding ESSR Catch	3,700	110,400	337,400	7,400	22,300	481,100	
Deviation from TAC + Payback + AFE	-3,700	117,100	74,100	14,000	9,100	210,600	
TOTAL							
Available TAC + U.S. Payback + AFE	0	250,800	436,200	24,300	34,000	745,300	
Total Catch	3,700	120,300	372,100	8,600	25,800	530,500	
Deviation from TAC + U.S. Payback + AFE	-3,700	130,500	64,100	15,700	8,200	214,800	

* The adjusted spawning escapement target cannot exceed the estimated abundance.

** Washington sockeye share according to Annex IV of the Pacific Salmon Treaty and Feb. 15, 2008, Commission Guidance.

APPENDIX J: STAFF OF THE PACIFIC SALMON COMMISSION IN 2008

EXECUTIVE OFFICE

Don Kowal, Executive Secretary
Kimberly Bartlett, Secretary/Receptionist
Sandie Gibson, Information Technology Support Specialist
Kathy Mulholland, Information Technology Manager
Vicki Ryall, Meeting Planner
Teri Tarita, Records Administrator/Librarian

FINANCE AND ADMINISTRATION

Ken Medlock, Controller
Bonnie Dalziel, Accountant
Angus Mackay, Manager, Restoration & Enhancement Funds
Victor Keong, Program Assistant, Restoration & Enhancement Funds

FISHERIES MANAGEMENT DIVISION STAFF

Mike Lapointe, Chief Biologist

Catherine Michielsens, Quantitative Biologist

BIOMETRICS GROUP

Ian Guthrie, Head

STOCK IDENTIFICATION GROUP

Jim Gable, Head
Holly Anozie, Assistant Scale Analyst (Acting)
Steve Latham, Sockeye Stock Identification Biologist
Maxine Forrest, Senior Scale Analyst
Julie Sellars, Assistant Scale Analyst
Zac Semeniuk, Resource Management Technician
Brian Wells, Scale Lab Assistant (term)
Bruce White, Pink Stock Identification Biologist

STOCK MONITORING GROUP

Jim Cave, Head
Jacqueline Boffey, Hydroacoustic Technician (Term)
Keith Forrest, Test Fishing Biologist
Andrew Gray, Hydroacoustics Biologist
Fiona Martens, Hydroacoustic Technician
Yunbo Xie, Hydroacoustics Scientist

APPENDIX K: MEMBERSHIP OF THE FRASER RIVER PANEL TECHNICAL COMMITTEE IN 2008

2008 Technical Committee Members	
United States	**Canada**
G. Graves, Co-Chair *Northwest Indian Fisheries Commission*	L. Jantz, Co-Chair *Fisheries and Oceans Canada*
S. McAvinchey *National Marine Fisheries Service*	A. Cass *Fisheries and Oceans Canada*
P. McHugh *Washington Department of Fish and Wildlife*	R. Goruk *Fisheries and Oceans Canada*
	A. Huang *Fisheries and Oceans Canada*
	M. Staley *First Nations Advisor*